HEALTHCARE-ASSOCIATED INFECTIONS IN MICHIGAN HOSPITALS

2012 ANNUAL REPORT

Michigan Department of Community Health

Surveillance for Healthcare-Associated & Resistant Pathogens (SHARP) Unit

January 1 – December 31, 2012

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Introduction

This report includes statewide healthcare-associated infection (HAI) counts, rates, and ratios in Michigan from January through December, 2012. Surveillance data were collected from Michigan hospitals which voluntarily agreed to share their National Healthcare Safety Network (NHSN) data with the Michigan Department of Community Health (MDCH) Surveillance for Healthcare-Associated and Resistant Pathogens (SHARP) Unit. NHSN is a secure online surveillance system developed by the Centers for Disease Control and Prevention (CDC). Hospitals sign a MDCH SHARP data use and confidentiality agreement (DUA) and confer rights to MDCH SHARP to view their NHSN HAI data. All NHSN data collected from participating hospitals have been aggregated and facility de-identified in this report. Aggregated data have been analyzed for trends and compared with national data where appropriate. Data are displayed only when 5 or more facilities are included in the analyses.

The SHARP Unit collects data from all modules within NHSN. In this annual report, participating hospitals are characterized by hospital affiliation, geographic region, and bed size. This report also describes units under surveillance by participating hospitals and the modules used. This annual report and previous quarterly, semi-annual, and annual reports are published on the MDCH HAI website at www.michigan.gov/hai. Note that this is the first calendar year annual report. Previous annual and semi-annual reports followed the MDCH fiscal year of October through September. When trends are displayed in this report, comparisons are made to the previous Annual Report (October 2010-September 2011), not the 2011-2012 Semi-Annual Report (October 2011-March 2012), to ensure that the data do not overlap.

As of the data access date (August 22, 2013) 83 hospitals had signed a data use and confidentiality agreement (DUA) with MDCH SHARP. At that time, all 83 hospitals had conferred rights to SHARP and had a reporting plan in place for at least one month during the inclusive time period. The data from these 83 hospitals were used for development of this report; however, not all participating hospitals provided data for every module. The number of hospitals providing data for analysis is indicated in each table throughout this report and reflects the number of hospitals contributing data to NHSN and sharing that data with MDCH SHARP. For example, although 83 hospitals had conferred rights to their data with at least one monthly reporting plan in place for the time period between January 1 and December 31, 2012, at the data access date (see Table 1 below), only 79 hospitals had the Catheter-Associated Urinary Tract Infection (CAUTI) module in their reporting plan; of these, 78 shared data (Table 6). The text "n=…" is used to indicate the number of hospitals or units being referenced.

Hospital Descriptives and Surveillance

Figure 1 (below) is a graphical representation of the number of facilities who have signed the MDCH SHARP DUA. Hospitals that have agreed to share data with the SHARP Unit are shown by the blue trend line, labeled "Master Agreement." The MDCH SHARP Unit DUA also provides an option to share data with the Michigan Health & Hospital Association (MHA) Keystone Center for Patient Safety & Quality. Hospitals who have agreed to share these data are shown by the red trend line labeled "MHA Data Release". Hospitals can also share Central Line-Associated Bloodstream Infection (CLABSI) data from neonatal intensive care units (NICU) with the Vermont Oxford Network (VON) via the SHARP Unit. These are represented by the green line labeled "VON Data Release."

Figure 1. Number of Michigan Hospitals that have a signed Data Use Agreement (DUA) with SHARP

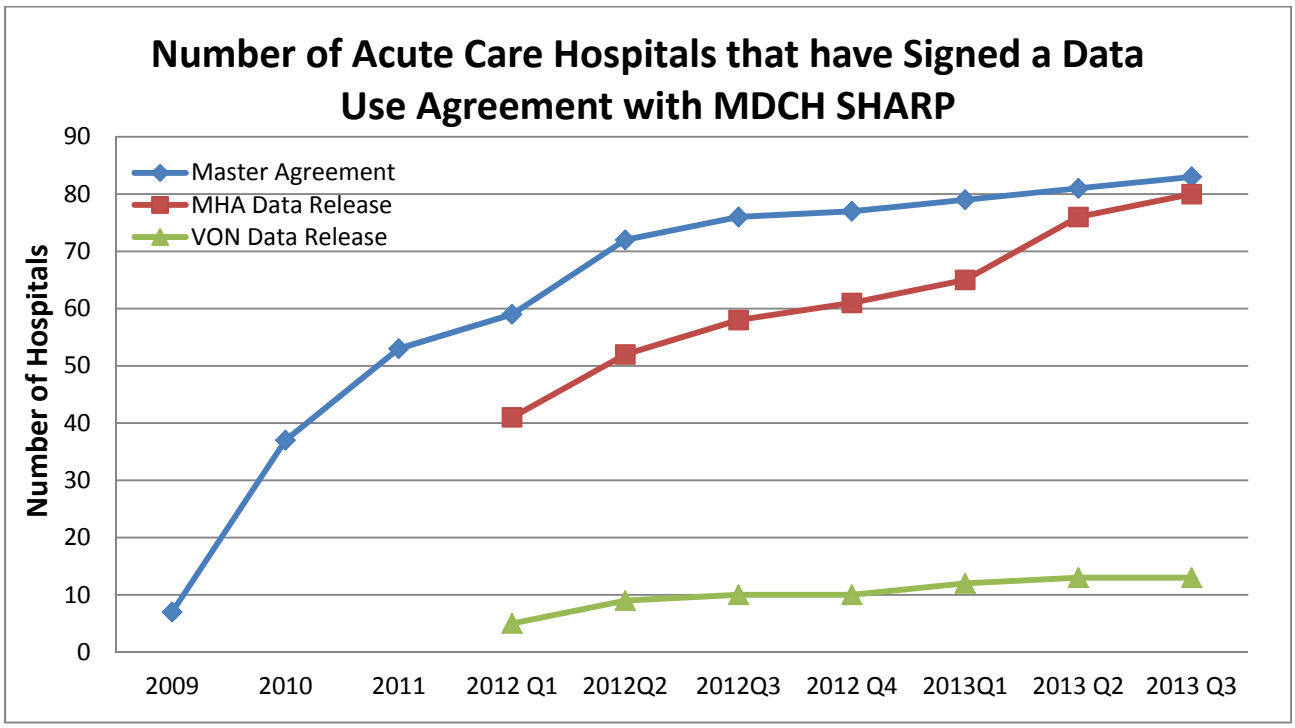
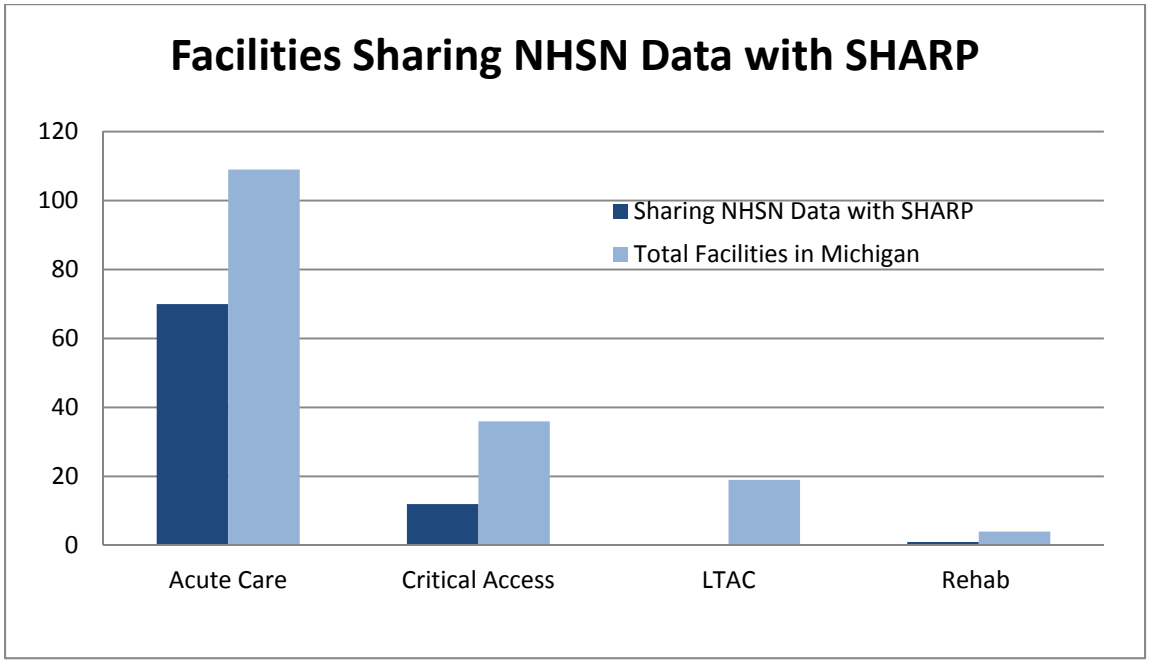


Table 1 and Figure 2 reflect the number of hospitals who have signed a DUA and conferred rights to the SHARP Unit by hospital type compared to the total of each hospital type in Michigan. Forty-nine percent of Michigan hospitals shared data with the SHARP Unit as of the data access date; 84% of participating hospitals were acute care hospitals. Hospital licensure data were obtained from a list generated by the Michigan Department of Licensing and Regulatory Affairs (LARA) on October 13, 2013. There are 19 LTACs in Michigan; however, none of these hospitals are sharing data with the SHARP Unit at this time. Therefore, the number of hospitals enrolled in the SHARP NHSN Group includes acute care hospitals, critical access hospitals, and rehab facilities only. As a requirement of some Centers for Medicare & Medicaid Services (CMS) programs, acute care hospitals and rehab facilities must report certain infections to NHSN; critical access hospitals had no such requirements in 2012.

Table 1. **Hospitals Sharing Data with MDCH SHARP Unit**					
	Acute Care	Critical Access	Long Term Acute Care	Rehab	**Total**
Number of Facilities (% of MI, % of Total)	70 (64, 84)	11 (33, 13)	0 (0, 0)	1 (25, 13)	**83 (49, 100)**
Michigan Total	109	36	19	4	**168**

Figure 2. Types of Facilities Sharing NHSN Data with SHARP



The data in Table 2 were obtained from the 2011 NHSN Annual Facility Survey completed by participating hospitals. Among the 83 facilities which completed an annual survey, hospital affiliation is relatively evenly split between teaching and non-teaching.

Table 2. **Hospital Affiliation**				
Hospital Type	Teaching[1]	Non-teaching	Unknown	Total
Number of Facilities (% of Total)	43 (52)	39 (47)	1 (1)	83
[1]Teaching includes major, graduate, and limited affiliation with medical schools as indicated on their facility survey				

To characterize the geographic distribution of the participating hospitals, hospital locations were categorized according to Public Health Preparedness Regions. The number of participating hospitals by region is indicated in Table 3 (below). The Public Health Preparedness Regions and the counties they include are shown on the map in Figure 3, and a map indicating the number of SHARP-participating facilities by region is shown in Figure 4.

Table 3.

Number of Participating Hospitals by Region

Geographic Region	**1**	**2N**	**2S**	**3**	**5**	**6**	**7**	**8**
Number of Facilities	6	11	14	13	11	14	7	7

Figure 3. Michigan Public Health Preparedness Regions

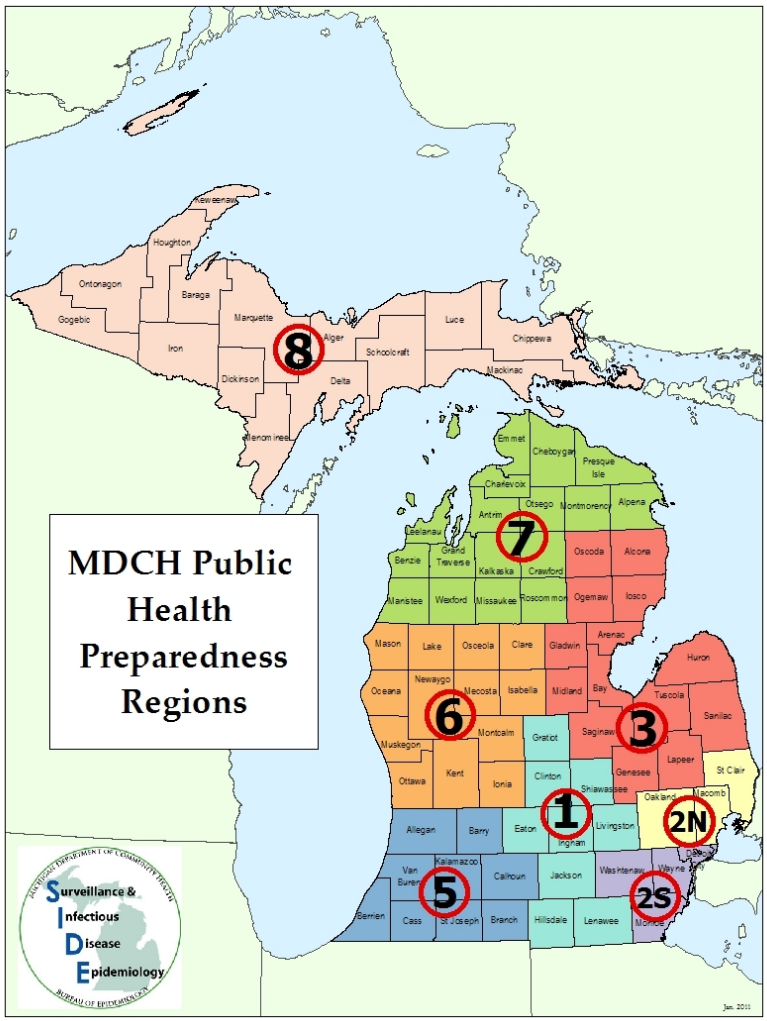


Figure 4. Facilities Participating with MDCH SHARP by Michigan Public Health Preparedness Region

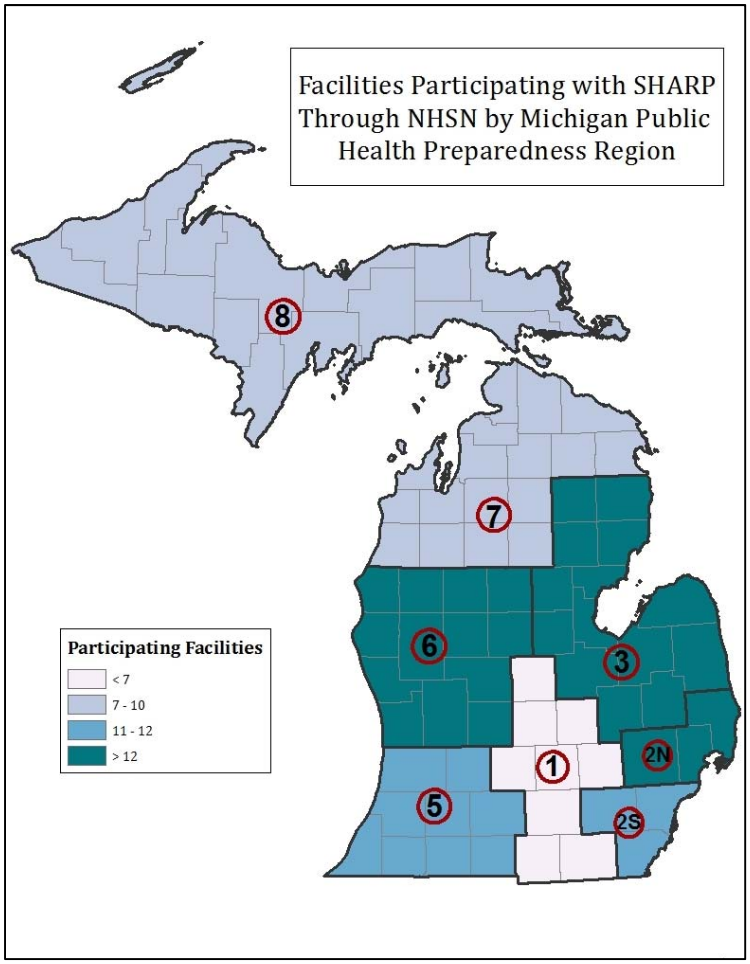


Table 4 shows the number of hospitals of each bed size type participating in SHARP NHSN surveillance. The majority of participating hospitals had 100 or fewer beds.

Table 4.

Number of Hospitals by Bed Size

Number of Beds in Hospital	**≤100**	**101 – 200**	**201 – 500**	**501 +**	**TOTAL**
Number of Facilities (% of Total)	31 (37)	15 (18)	27 (33)	10 (12)	**83**

Table 5 indicates that the majority of hospitals participating in SHARP NHSN surveillance are conducting NHSN surveillance in their intensive care units (ICUs). The ICU type is not specified in this report. Many hospitals are also conducting surveillance on one or more patient wards. Ten hospitals are conducting

surveillance in a Specialty Care Area (SCA) or a step-down unit (STEP). According to the CDC NHSN Patient Safety Manual, a SCA may be an inpatient long-term acute care unit, a transplant unit, an acute dialysis unit, or a hematology/oncology unit, although this unit type is will no longer be relevant in future reports. It also should be noted that some hospitals are monitoring multiple unit types within their facility, including 36 hospitals monitoring facility-wide.

Table 5.

Types of Units in Reporting Plan

Unit Type	FacWideIn[2]	ICU/CCU[3]	SCA/STEP[4]	Wards[5]	Other Inpatient[6]	Outpatient[7]
Number of Facilities (% of Total)[1]	36 (43)	74 (89)	10 (12)	59 (71)	9 (11)	16 (19)

[1]These numbers are not mutually exclusive
[2]FacWideIn: All Facility-Wide Inpatient locations
[3]ICU/CCU: Intensive Care Unit/Critical Care Unit
[4]SCA/STEP: Specialty Care Area/Step-Down Unit
[5]Wards: Inpatient wards
[6]Other: All other inpatient locations, including inpatient rehab facilities, operating rooms, and locations designated as "other"
[7]Outpatient: All Outpatient locations

Table 6 indicates the NHSN module(s) in use, as indicated by monthly reporting plans developed by each participating hospital. From month to month, the type of module(s) being used can change as some modules require varying periods of use. According to data shared with MDCH SHARP, two of the most commonly used modules during this reporting period were the CAUTI and CLABSI modules. This is not surprising because of the previous work done by hospitals in conjunction with the MHA Keystone Center to reduce these types of infections. Use of the CAUTI, CLABSI, and Surgical Site Infection (SSI) modules are also consistent with the CMS Hospital Inpatient Prospective Payment System (IPPS) reporting rules. Beginning January 1, 2011, hospitals were required to use NHSN to report CLABSIs in adult, pediatric, and neonatal ICUs in order to receive full Medicare reimbursements in 2013. They were required to report CAUTIs in adult and pediatric ICUs, and SSI colon surgeries (COLO) and abdominal hysterectomies (HYST) beginning January 1, 2012. LTACs were required to report CLABSIs and CAUTIs in adult and pediatric ICUs and Wards beginning in, and rehab facilities were required to report CAUTIs in adult and pediatric wards, both beginning in October 2012.

The column in Table 6 titled "Number of Hospitals Using Module" displays the number of hospitals that have indicated module use in their reporting plans for at least one month during this report time period. A monthly reporting plan identifies which NHSN modules and surveillance activities a hospital will be participating in during a given month. Because surveillance targets and monthly reporting plans may vary by hospital and month, hospitals may not report to NHSN each month. The SHARP Unit has requested at least three consecutive months of data for the NHSN surveillance initiative.

The column titled "Number of Hospitals Sharing Data" displays the number of hospitals that have shared data for this report time period as of the data access date. There is a discrepancy between these two columns in some instances because not all hospitals that indicate module use necessarily report data and some hospitals report out-of-plan data which cannot be excluded from certain calculations. The SHARP Unit excludes out-of-plan data when possible because it may not follow NHSN definitions as closely as in-plan data.

Table 6.

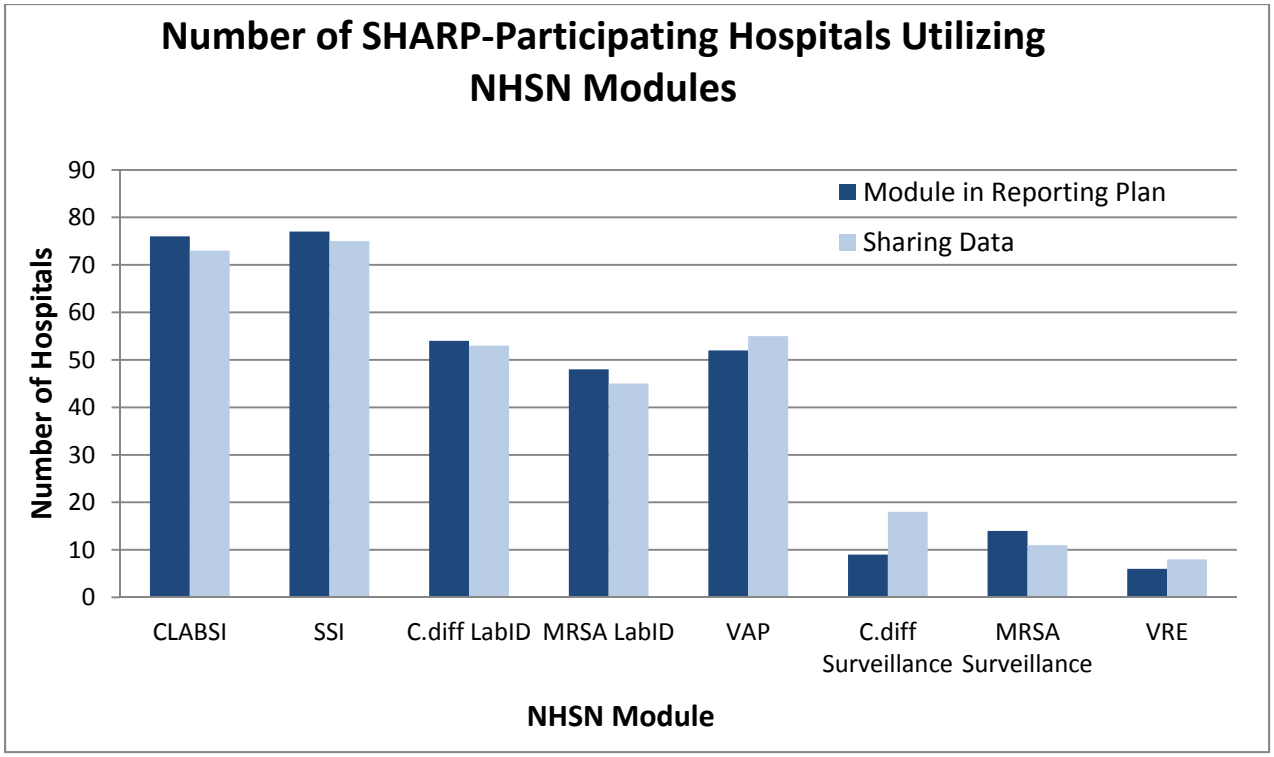
NHSN Modules in use

NHSN Module	Number of Hospitals Using Module[1]	Number of Hospitals Sharing Data[2]
Catheter-Associated Urinary Tract Infection (CAUTI)	79	78
Central Line-Associated Bloodstream Infection (CLABSI)	76	73
Surgical Site Infection (SSI)	77	75
Ventilator-Associated Pneumonia (VAP)	52	55[3]
Clostridium difficile Infection (CDI) Laboratory-identified (LabID) Event	54	53
Methicillin-Resistant Staphylococcus aureus (MRSA) Laboratory-identified (LabID)	48	45
Methicillin-Resistant Staphylococcus aureus (MRSA) Infection Surveillance	14	11
Vancomycin-Resistant Enterococci (VRE) LabID	15	15
Clostridium difficile Infection (CDI) Surveillance	9	18
Vancomycin-Resistant Enterococci (VRE) Infection Surveillance	6	8
Acinetobacter LabID	7	N/A[4]
Cephalosporin Resistant Klebsiella LabID	5	N/A
Carbapenem-resistant Enterobacteriaceae LabID	6	N/A
Acinetobacter Infection Surveillance	<5	N/A
Cephalosporin Resistant Klebsiella Infection Surveillance	<5	N/A
Carbapenem-resistant Enterobacteriaceae Infection Surveillance	<5	N/A

[1]This is the number of hospitals that have indicated module use in their reporting plans for at least one month within the six month time period.
[2]This is the number of hospitals sharing data for the report period, as of the data access date.
[3]In some instances, the number of hospitals sharing data is greater than the number of hospitals using the module. Some hospitals are reporting data out-of-plan; out-of-plan data are included only when impossible to remove.
[4]N/A: data from these modules were not collected for this report.

Figure 5 (below) illustrates the number of SHARP-participating hospitals utilizing each of the NHSN modules. The darker blue bar indicates the number of hospitals using the module for at least one month in the time period from January to December 2012. The lighter blue bars indicate the number of hospitals sharing data for at least one month in the same time period.

Figure 5. SHARP-Participating Hospitals Utilizing NHSN Modules



Cumulative Annual Aggregate MDRO/CDI Module Reports

Table 7 shows aggregate MRSA LabID Event data by quarter, previously posted in each respective quarterly report, along with cumulative data for the annual time period. Due to different abstraction dates and variable data shared during each respective time period, quarterly report values may not sum to annual report values.

The NHSN definition for MDRO LabID Event is 'all non-duplicate MDRO isolates [in this case MRSA isolates] from any specimen source and unique blood source MDRO [MRSA] isolates, including specimens collected during an Emergency Department or other clinic visit, if collected the same day as patient admission'. A unique blood source is defined as 'a MDRO [MRSA] isolate from blood in a patient with no prior positive blood culture for the same MDRO [MRSA] and location in ≤2 weeks, even across calendar months.' A duplicate MDRO isolate is defined as 'any MDRO [MRSA] isolate from the same patient and location after an initial isolation of the specific MDRO [MRSA] during a calendar month, regardless of specimen source except unique blood source'. The specimens must be obtained for clinical decision-making purposes to be considered a LabID Event; thus, isolates obtained for 'surveillance purposes only' will not be reflected in this data. Additionally, testing protocol and type of test used (i.e. PCR, assay, culture) vary by facility and are not recorded here.

NHSN defines healthcare-onset (HO) as a 'LabID Event specimen collected >3 days after admission to the facility (i.e., on or after day 4).' Community-onset (CO) is defined by NHSN as a 'LabID Event specimen collected as an outpatient or an inpatient ≤3 days after admission to the facility (i.e., days 1, 2, or 3 of admission).' It should also be noted that LabID Event data do not necessarily indicate infection, but denote a positive lab test result from a specimen collected for clinical purposes. MRSA is known to colonize skin and mucosal membranes without causing infections. LabID data provide a proxy measure for MRSA prevalence.

Table 7.

Cumulative Aggregate Methicillin-Resistant Staphylococcus aureus (MRSA) LabID Data

	January – March 2012	April – June 2012	July – September 2012	October - December 2012	**Cumulative Data January – December 2012[1]**
Frequency, Number					
Hospitals with a DUA[2]	73	76	79	82	**83**
Hospitals reporting MRSA LabID[3]	33	36	35	30	**48**
Hospitals sharing MRSA LabID	28	36	29	40	**40**
Aggregated LabID Events	1142	1289	1322	1387	**5562**
Onset, Number (%)					
Healthcare Facility-Onset (HO)	188 (16)	230 (18)	196 (15)	248 (18)	**910 (16)**
Community-Onset (CO)	954 (84)	1059 (82)	1126 (85)	1139 (82)	**4652 (84)**
Specimen Source, Number (%, %HO)[4]					
Blood	96 (18)	98 (31)	121 (22)	158 (27)	**489 (8, 25)**
Sputum	163 (42)	153 (39)	128 (39)	122 (38)	**576 (10, 40)**
Wound	345 (8)	404 (11)	480 (5)	452 (10)	**1717 (31, 8)**
Abcess	44 (9)	102 (10)	161 (8)	228 (6)	**757 (14, 6)**
Urine	116 (11)	127 (9)	111 (9)	124 (6)	**507 (9, 9)**
Skin	16 (6)	6 (0)	6 (17)	8 (0)	**41 (1, 7)**
Other	362 (16)	399 (19)	315 (22)	295 (32)	**1475 (27, 22)**
Surveillance Location, Number (%, %HO)[5]					
Intensive/Critical Care Unit	244 (21, 39)	280 (22,	272 (21, 34)	315 (23, 43)	**1179 (21, 38)**
Specialty Care Area	14 (1, 29)	21 (2, 52)	----	----	**----**
Wards	487 (43, 18)	528 (41,	544 (41, 19)	500 (36, 23)	**2150 (39, 21)**
Outpatient	397 (35, 0)	460 (36, 0)	506 (38, 0)	572 (41, 0)	**2228 (40, 0)**

[1]Cumulative Data includes 2012 data pulled on the data access date. Each quarterly column is pulled from the MDCH SHARP Quarterly Reports, found at www.michigan.gov/hai.
[2]DUA: Data Use Agreement. This is a document signed between the hospital and the Michigan Department of Community Health which outlines how the data will be shared and used, and how confidentiality will be protected.
[3]MRSA Lab ID: Methicillin-Resistant *Staphylococcus aureus* (MRSA) Laboratory-Identified (LabID) Event. This is an option within the Multidrug-Resistant Organism / *Clostridium difficile* Infection (MDRO/CDI) Module of NHSN for tracking laboratory results without conducting additional surveillance for infections.
[4]The number in parentheses under "Specimen Source" is the percent of isolates obtained from that source which are healthcare-onset.
[5]The numbers in parentheses under "Surveillance Location" are the percent of isolates from each location, followed by the percent of isolates from each location which are healthcare-onset.

MRSA LabID event data remained stable throughout the year. Sixteen percent of the aggregate events were considered HO, and 84% were determined to be CO. The majority of specimens were from wounds, but only 8% of wound specimens were considered HO. Sputum specimens accounted for only 10% of all specimens, but 40% of these specimens were healthcare facility-onset. The majority of events came from outpatient locations, followed by wards. However, the location with the greatest percentage of HO events was the ICU/CCU.

Table 8 shows aggregate CDI LabID data by quarter, previously posted in each respective quarterly report, along with cumulative data for 2012. Again, due to different abstraction dates and different amounts of data being shared during each respective time period, quarterly report values may not sum to annual report values.

Table 8 displays the number of positive CDI LabID Events entered by facility per quarter following the NHSN definitions. The NHSN definition for a CDI LabID Event is 'all non-duplicate MDRO isolates [in this case, CDI detection via stool culture or a positive CDI assay] from any specimen source, including specimens collected during an Emergency Department or other clinic visit, if collected the same day as patient admission'. For CDI, a duplicate MDRO isolate is defined as 'any MDRO [CDI] isolate [assay] from the same patient and location after an initial isolation [assay] of the specific MDRO [CDI] during a calendar month'. The specimens must be obtained for clinical decision-making purposes to be considered a LabID Event, thus specimens obtained for 'surveillance purposes only' will not be reflected in this data. Additionally, testing protocol and type of test used (i.e. PCR, assay, culture) vary by facility and are not recorded here.

NHSN defines 'healthcare facility-onset' (HO) as a 'LabID Event specimen collected >3 days after admission to the facility (i.e., on or after day 4).' 'Community-onset' (CO) is defined by NHSN as a 'LabID Event specimen collected as an outpatient or an inpatient ≤3 days after admission to the facility (i.e., days 1, 2, or 3 of admission).' Community-onset healthcare facility-associated' (CO-HCFA) is defined as a 'CO LabID Event specimen collected from a patient who was discharged from the facility ≤ 4 weeks prior to specimen collection.' It should also be noted that LabID Event data do not necessarily indicate infection, but denote a positive lab test result from a specimen collected for clinical purposes. LabID data provide a proxy for CDI prevalence.

Table 8.

Cumulative Aggregate Clostridium difficile Infection (CDI)[1] LabID Data

	January – March 2012	April – June 2012	July – September 2012	October – December 2012	**Cumulative Data January – December 2012[2]**
Frequency, Number					
Hospitals with DUA[3]	73	76	79	82	**83**
Hospitals Reporting CDI LabID[4]	42	44	44	48	**54**
Hospitals Sharing CDI LabID	37	40	40	44	**54**
Aggregated LabID Events	991	934	955	1136	**4078**
Onset, Number (%)					
Healthcare Facility-Onset (HO)	359 (36)	270 (29)	341 (36)	414 (36)	**1399 (34)**
Community-Onset Healthcare Facility-Associated (CO-HCFA)	183 (18)	178 (19)	163 (17)	191 (17)	**723 (18)**
Community-Onset (CO)	449 (45)	486 (52)	451 (47)	531 (47)	**1950 (48)**
Previous CDI, Number (%)					
Previously Positive	110 (11)	109 (12)	136 (14)	134 (12)	**498 (12)**
CDI assay, recurrent	67 (7)	66 (7)	80 (8)	49 (4)	**277 (7)**
Surveillance Location, Number (%, %HO)[5]					
Intensive/Critical Care Unit	196 (20, 56)	175 (19,	171 (18, 60)	264 (23, 49)	**840 (21, 51)**
Specialty Care Area	61 (6, 57)	65 (7, 43)	4 (0, 50)	1 (0, 100)	**15 (0, 40)**
Wards	548 (55, 39)	524 (56,	624 (65, 38)	730 (64, 39)	**2548 (63, 38)**
Outpatient	186 (19, 0)	170 (18,	155 (16, 0)	139 (12, 0)	**666 (16, 0)**

[1]The specimen source of all *C.difficile* isolates is stool (100%)
[2]Cumulative Data includes 2012 data pulled on the data access date. Each quarterly column is pulled from the MDCH SHARP Quarterly Reports, found at www.michigan.gov/hai.
[3]DUA: Data Use Agreement. This is a document signed between the facility and the Michigan Department of Community Health which outlines how the data will be shared and used.
[4]CDI Lab ID: *Clostridium difficile* Infection (CDI) Laboratory-Identified (LabID) Event. This is an option within the Multidrug-Resistant Organism/*Clostridium difficile* Infection (MDRO/CDI) Module of NHSN for tracking laboratory results without conducting additional surveillance for infections.
[5]The numbers in parentheses under "Surveillance Location" are the percent of isolates from each location, followed by the percent of isolates from each location which are healthcare-onset.

The distributions of CDI LabID events remained stable throughout 2012. Thirty-four percent of events were HO, 18% CO-HCFA, and 48% CO. All four quarters in 2012 indicated a similar distribution. Twelve percent of events were previously positive, and 7% were considered recurrent. The greatest percentage of events came from wards; however, only 38% of these events were HO. As with MRSA LabID events, the surveillance location with the greatest percentage (51%) of HO events was the ICU/CCU.

Cumulative Annual Aggregate Rates

Table 9 provides the 2012 annual Michigan MRSA inpatient LabID rate, outpatient LabID rate, and surveillance rate. There are currently no national rates available for MDRO/CDI data.

Table 9.

Cumulative Michigan MRSA Rate

	Facilities	Number of MRSA Events	Number of Patient Days	Number of Patient Admits/Encounters	MRSA Rate[1]	MRSA Prevalence Rate[2]
MRSA Inpatient LabID[3]	45	2921 LabID[4]	1,516,757	351,720 Admits	1.9258 ↓	0.8305 ↓
MRSA Outpatient LabID[5]	11	1528 LabID	----	643,410 Encounters	----	0.2375
MRSA Surveillance	17	24 Infections[6]	98,591	----[7]	0.2434	----

Michigan Data

[1]MRSA Rate: Methicillin-Resistant *Staphylococcus aureus* (MRSA) rate. This is the number of MRSA LabID Events or surveillance infections per 1,000 patient days. ↑: significant rate increase from previous annual report, ↓: significant rate decrease from previous annual report.
[2]MRSA Prevalence Rate. This is the number of MRSA LabID Events per 100 patients admitted or 100 encounters.
[3]MRSA Lab ID: MRSA Laboratory-Identified (LabID) Event. This is an option within the Multidrug-Resistant Organism / *Clostridium difficile* Infection (MDRO/CDI) Module of NHSN for tracking laboratory results without conducting additional surveillance for infections.
[4]The number of MRSA LabID Events indicated in this table is less than the number of MRSA LabID Events indicated in Table 7. This is because events used to calculate a rate required denominator data (patient days and/or admissions). Those without denominator data were excluded from the calculation.
[5]MRSA outpatient LabID: MRSA LabID specimen collected in an outpatient location, and reported only if the hospital is reporting outpatient events. These events are also reported in inpatient locations, and are attributed to the admitting location.
[6]Infection: MRSA event under infection surveillance. This is an option in the Multidrug-Resistant Organism / *Clostridium difficile* Infection (MDRO/CDI) Module for tracking infections through surveillance.
[7]The infection surveillance module does not collect the number of patient admissions; therefore this number is unavailable and a MRSA Infection Surveillance Prevalence Rate cannot be calculated.

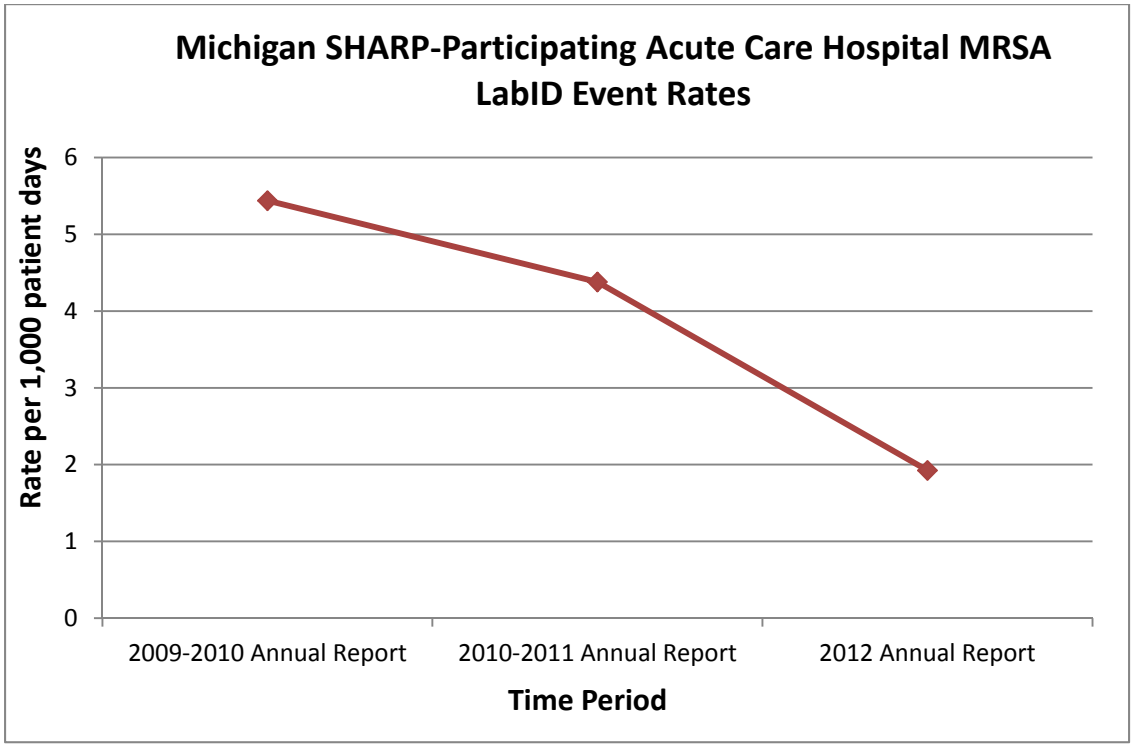
The 2012 annual Michigan MRSA inpatient LabID rate was 1.9258 events per 1,000 patient-days, which showed a significant decrease from the last annual report LabID rate of 4.3791 ($p<0.0001$). This number is calculated by dividing the number of total inpatient MRSA LabID Events by the number of patient days. The MRSA prevalence rate is calculated by dividing the number of inpatient MRSA LabID Events by the number of patient admissions. The annual Michigan MRSA prevalence rate was 0.8305 per 100 patient admissions, significantly less than the previous annual MRSA prevalence rate of 1.8460 per 100 patient days ($p<0.0001$). Note that LabID event data do not necessarily indicate infection, but denote a positive lab test result from a specimen collected for clinical purposes. LabID data provide a proxy measure for MRSA prevalence.

In addition to LabID surveillance, hospitals may also conduct MRSA infection surveillance via NHSN. The definition for a MRSA infection surveillance event includes *S. aureus* cultured from any specimen that tests oxacillin-resistant, cefoxitin-resistant, or methicillin-resistant by standard susceptibility testing

methods or by a laboratory test that is FDA-approved for MRSA detection from isolated colonies; these methods may also include a positive result by any FDA-approved test for MRSA detection from that source. There were 17 hospitals that participated in this option during the time period under study, providing an overall MRSA infection surveillance rate of 0.2434 per 1,000 patient days. A MRSA infection surveillance prevalence rate cannot be calculated because patient admissions are not collected in the infection surveillance module.

Figure 6 is a graphical demonstration of the Michigan MRSA LabID event rates from the 2009-2010 annual report through the 2012 annual report. The 2010-2011 MRSA LabID rate was statistically significantly lower than the 2009-2010 LabID event rate, and the 2012 LabID rate was statistically significantly lower than the 2010-2011 MRSA LabID rate.

Figure 6. Michigan MRSA LabID Event Rate Trend



In table 10 (below), Michigan inpatient MRSA LabID rates are stratified by onset. HO events occur when the LabID specimen was collected on or after day 4 of admission to the facility. Because they are incident events, only a MRSA incidence rate can be calculated. CO events occur when the LabID specimen was collected ≤3 days after admission to the facility. These are prevalent events, so a MRSA prevalence rate is calculated.

Table 10.

Michigan Inpatient MRSA LabID Rate by Onset

Number of Facilities	Onset	Number of Inpatient MRSA Events	Number of Patient Days	Number of Patient Admits	MRSA HO[1] Incidence Rate[2]	MRSA CO[3] Prevalence Rate[4]	Percentage
45	HO	620 LabID[5]	1,516,757	----	0.4088	----	23
45	CO	2123 LabID	----	351,720	----	0.6036	77

Michigan Rate

[1]HO: Healthcare facility-onset

[2]MRSA HO Incidence Rate: Methicillin-Resistant *Staphylococcus aureus* (MRSA) rate. This is the number of incident HO MRSA LabID Events per 1,000 patient days. Prior to the Quarter 3, 2012 report, this rate included both prevalent and incident HO MRSA LabID events; currently, prevalent HO MRSA LabID events are not included. Previous positive MRSA events are not included.

[3]CO: Community-onset

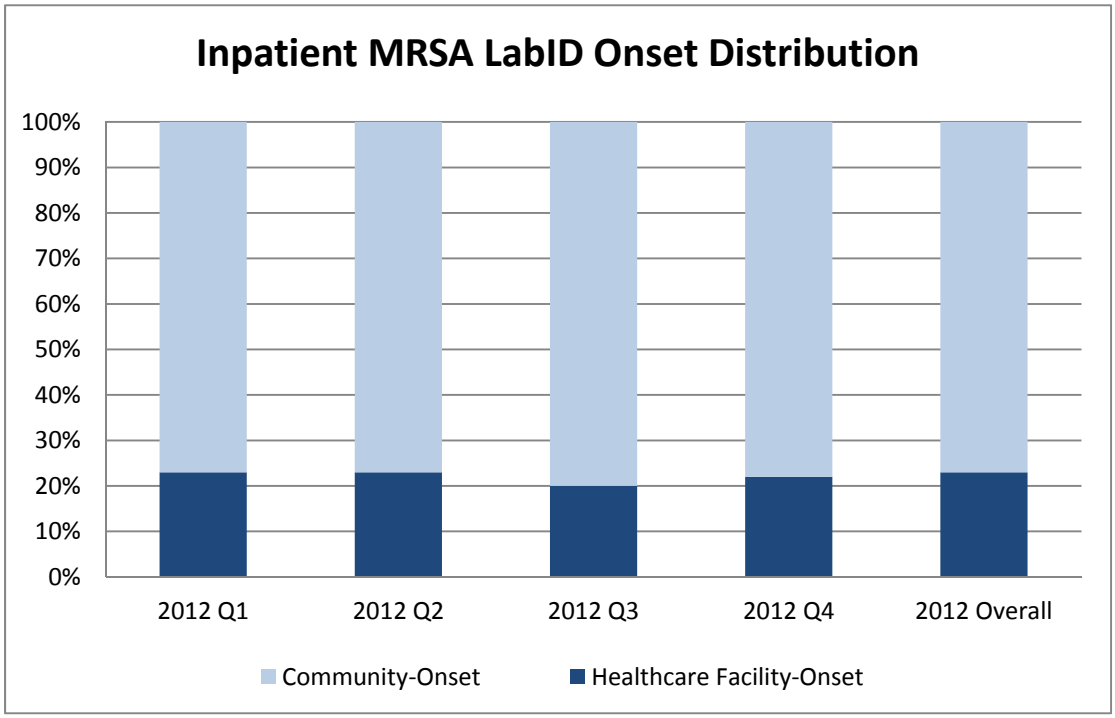
[4]MRSA CO Prevalence Rate. This is the number of MRSA LabID Events per 100 patients admitted.

[5]MRSA Lab ID: MRSA Laboratory-Identified (LabID) Event. This is an option within the Multidrug-Resistant Organism / *Clostridium difficile* Infection (MDRO/CDI) Module of NHSN for tracking laboratory results without conducting additional surveillance for infections.

The HO incidence rate was 0.4088 per 1,000 patient days. Prior to the Quarter 3, 2012 report, the MRSA incidence rate included both prevalent and incident HO MRSA LabID events. This report only included incident HO LabID events, and excluded prevalent HO LabID events (LabID events that, although they are considered HO based on the date admitted to the facility, are considered prevalent because of the date admitted to a new location within the facility). Previous positive MRSA events are also excluded.

The CO prevalence rate was 0.6036 per 100 admissions. The percentage distributions of CO and HO LabID Events in Table 10 are slightly different from the percentage distributions in Table 7; there are fewer LabID events in Tables 9 and 10 than in Table 7 because only LabID events which had corresponding denominators (i.e. patient days) were included in the rate tables. The percentages of CO and HO should be very similar, but may not be identical. The majority (77%) of inpatient MRSA LabID events were CO. The remaining 23% were HO. The graphical display of the overall and quarterly distributions can be seen in Figure 7 (below).

Figure 7. Quarterly and Annual (Overall) MRSA LabID Rate by Onset



In Table 11 (below), the annual Michigan inpatient CDI rate and CDI prevalence rate are provided along with the CDI outpatient LabID rate and the CDI surveillance rate. Note that CDI LabID event data do not necessarily indicate infection but denote a positive lab test result from a specimen collected for clinical purposes. LabID Event data provide a proxy measure for *C. difficile* prevalence.

Hospitals may also conduct CDI Infection Surveillance via NHSN. The CDI infection surveillance event definition includes CDI events (i.e., *C. difficile* pathogen identified with a positive toxin result) that are not present or incubating at the time of admission (i.e., meets criteria for a healthcare-associated infection). As with MRSA Infection Surveillance data, a CDI infection surveillance prevalence rate cannot be determined because the number of patients admitted is not collected with Infection Surveillance data. Again, there are no national MDRO/CDI rates available to make comparisons with Michigan data.

Table 11.

Cumulative Michigan CDI Rate

	Facilities	Number of CDI Events	Number of Patient Days	Number of Patient Admits/Encounters	CDI Rate[1]	CDI Prevalence Rate[2]
CDI Inpatient LabID[3]	53	2933 LabID[4]	1,594,695	379,062 Admits	18.3922 ↑	0.7738 ↑
CDI Outpatient LabID	15	489 LabID	----	861,202 Encounters	----	0.0568
CDI Surveillance	18	24 Infections[5]	74,270	----[6]	3.2315	----

Michigan Data

[1]CDI Rate: *Clostridium difficile* rate. This is the number of CDI LabID or surveillance events per 10,000 patient days. ↑: significant rate increase from previous annual report, ↓: significant rate decrease from previous annual report.
[2]CDI Prevalence Rate. This is the number of *C. diff* LabID events per 100 patients admitted or per 100 encounters.
[3]CDI Lab ID: *Clostridium difficile* Infection (CDI) Laboratory-Identified (LabID) Event. This is an option within the Multidrug-Resistant Organism / *Clostridium difficile* Infection (MDRO/CDI) Module of NHSN for tracking laboratory results without conducting additional surveillance for infections.
[4]The number of CDI LabID Events indicated in this table is less than the number of CDI LabID Events indicated in Table 8. This is because events used to calculate a rate required denominator data (patient days and/or admissions). Those without denominator data were excluded from the calculation.
[5]Infection: *C. diff* event under infection surveillance. This is an option in the Multidrug-Resistant Organism / *Clostridium difficile* Infection (MDRO/CDI) Module for tracking infections through surveillance.
[6]The infection surveillance module does not currently provide the number of patient admissions; therefore this number is unavailable and a *C. diff* Prevalence Rate cannot be calculated.

The 2012 annual CDI rate increased significantly from 15.5481 to 18.3922 per 10,000 patient days ($p=0.0003$), and the prevalence rate also increased significantly from 0.5117 to 0.7738 per 100 admissions ($p<0.0001$) from the previous annual report. The CDI outpatient prevalence rate was 0.0568 per 100 admissions, and the CDI surveillance rate was 3.2315 per 10,000 patient days.

Figure 8 (below) shows the overall CDI LabID event rate trends from the last three annual reports. From the 2009-2010 Annual Report to the 2010-2011 Annual Report, there were no significant changes. However, from the 2010-2011 Annual Report to the 2012 Annual Report, the CDI LabID rate increased significantly.

Figure 8. Michigan CDI LabID Rate Trends

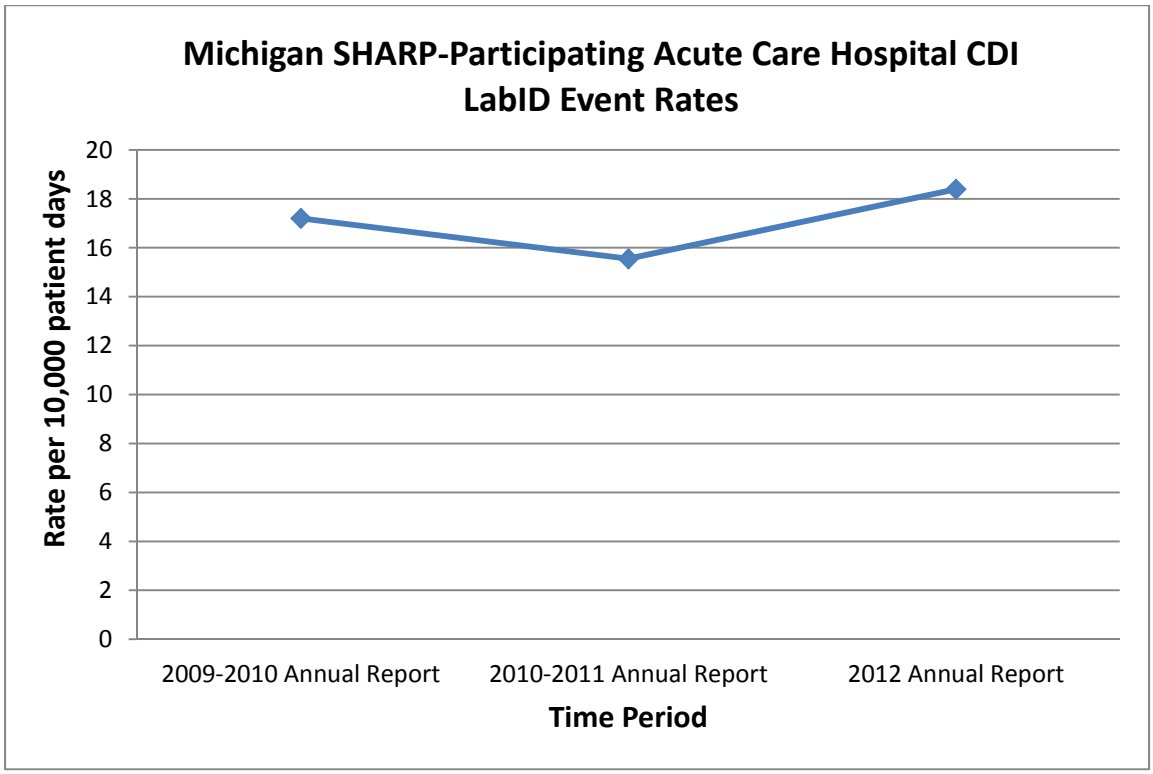


Table 12 (below) provides inpatient CDI LabID rates stratified by onset. HO and CO definitions are the same as for MRSA LabID. Community-onset, healthcare facility-associated (CO-HCFA) is defined as a CO LabID Event collected from a patient who was discharged from the facility ≤4 weeks prior to current date of stool specimen collection.

Table 12.

Michigan CDI LabID Rate by Onset

Number of Reporting Facilities	Onset	Number of Inpatient LabID CDI Events	Number of Patient Days	Number of Patient Admits	CDI HO[1] Incidence Rate[2]	CDI CO[3]/CO-HCFA[4] Prevalence Rate[5]	Percentage of Total
53	HO	1175 LabID[6]	1,594,695	----	7.3682	----	41
53	CO-HCFA	519 LabID	----	379,062	----	0.1369	18
53	CO	1196 LabID	----	379,062	----	0.3155	41

Michigan Data

[1]HO: Healthcare facility-onset
[2]CDI HO Incidence Rate: *Clostridium difficile* rate. This is the number of CDI LabID events or surveillance infections per 10,000 patient days. This is the number of incident HO CDI LabID Events per 10,000 patient days. Prior to the Quarter 3, 2012 report, this rate included both prevalent and incident HO CDI LabID events; currently, prevalent HO CDI LabID events are not included.
[3]CO:Community-onset
[4]CO-HCFA: Community-onset healthcare facility-associated
[5]CDI Prevalence Rate. This is the number of CDI LabID events per 100 patients admitted.
[6]CDI Lab ID: *Clostridium difficile* Infection (CDI) Laboratory-Identified (LabID) Event. This is an option within the Multidrug-Resistant Organism / *Clostridium difficile* Infection (MDRO/CDI) Module of NHSN for tracking laboratory results without conducting additional surveillance for infections.

The percentage distributions of CO, CO-HCFA, and HO LabID Events in Table 12 are slightly different from the distributions in Table 8. This can be explained by the greater number of overall LabID events in Table 8. The amount of LabID events in Tables 11 and 12 are lower than in Table 8 because only LabID events which had corresponding denominators (i.e. patient days) were included in the rate table. Therefore, the percentages of CO, CO-HCFA, and HO should be very similar, but may not be identical.

The CDI HO Incidence Rate was 7.3682 per 10,000 patient days. The present report only included incident HO LabID events, and excluded prevalent HO LabID events (LabID events that, although they are considered HO based on the date admitted to the facility, are considered prevalent because of the date admitted to a new location within the facility). The CDI CO Prevalence rate was 0.3155 per 100 admissions, and the CDI CO-HCFA Prevalence rate was 0.1369 per 100 admissions.

The majority (44%) of inpatient CDI LabID events were HO, closely followed by CO (38%). The remaining 18% were CO-HCFA. The graphical display of this can be seen below in Figure 9 (below).

Figure 9. Quarterly and Annual (Overall) CDI LabID Rate by Onset

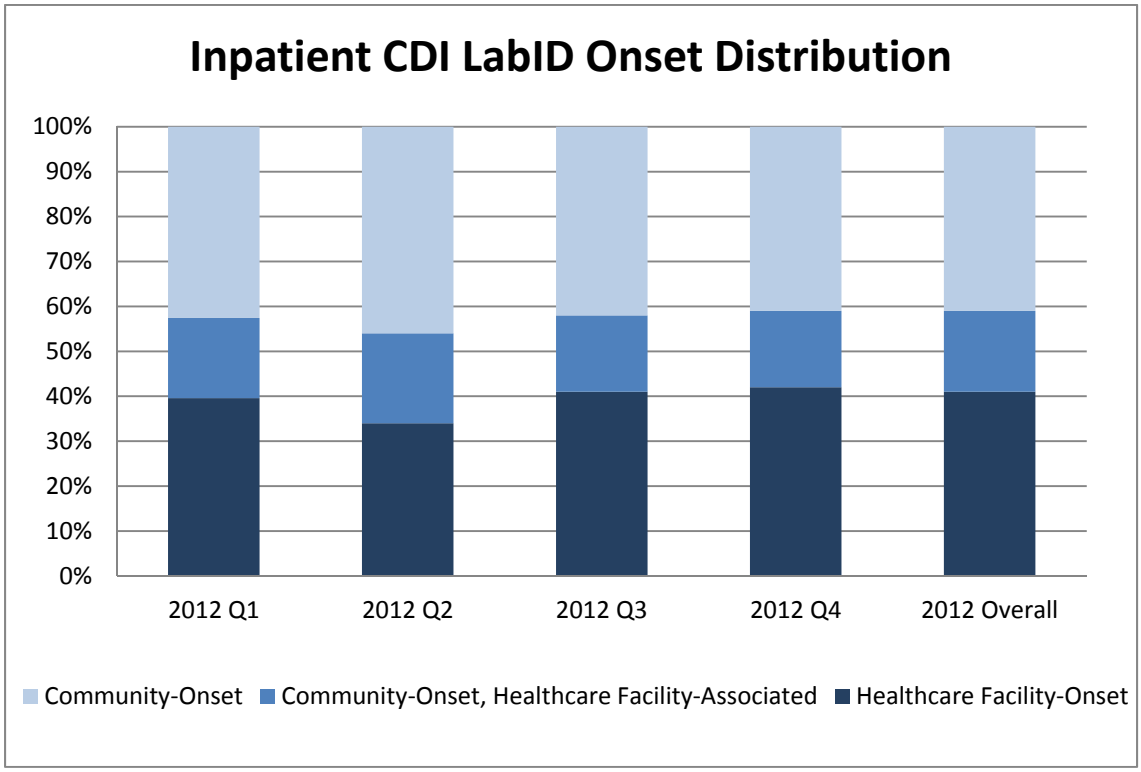


Table 13 shows the Inpatient Vancomycin-Resistant Enterobacteriaceae (VRE) LabID rates, the outpatient VRE LabID rate, and the VRE surveillance rate. As with MRSA and CDI, there is no comparative national rate for VRE.

Table 13.

Cumulative Michigan Vancomycin-Resistant Enterobacteriaceae (VRE) Rate

	Number of Facilities	Number of Inpatient VRE Events	Number of Patient Days	Number of Patient Admits/Encounters	VRE Rate[1]	VRE Prevalence Rate[2]
VRE Inpatient LabID	15	419 LabID[3,4]	415,543	89,352	1.0083 ↑	0.4689 ↑
VRE Outpatient LabID	5	12 LabID	-----	151,023	----	0.0079
VRE Surveillance	8	1 Infections[5]	39,691	----[6]	0.0252	----

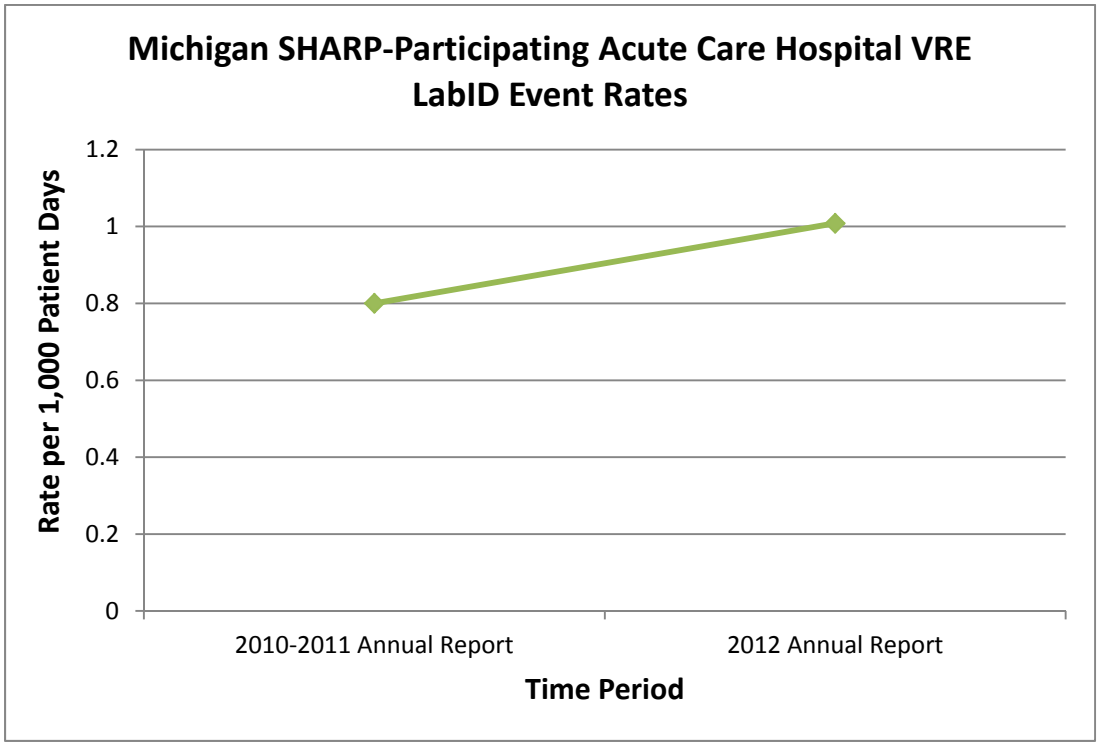
Michigan Rate

[1]VRE Rate: Vancomycin-Resistant Enterococci (VRE) rate. This is the number of inpatient VRE LabID Events or surveillance infections per 1,000 patient days or encounters. ↑: significant rate increase from previous annual report, ↓: significant rate decrease from previous annual report.
[2]VRE Prevalence Rate. This is the number of VRE LabID Events per 100 patients admitted.
[3]MRSA Lab ID: VRE Laboratory-Identified (LabID) Event. This is an option within the Multidrug-Resistant Organism / *Clostridium difficile* Infection (MDRO/CDI) Module of NHSN for tracking laboratory results without conducting additional surveillance for infections.
[4]The number of inpatient VRE LabID Events indicated here may be less than the total number of VRE LabID Events. This is because events used to calculate a rate required denominator data (patient days and/or admissions). Those without denominator data were excluded from the calculation.
[5] Surveillance Infection: VRE event under infection surveillance. This is an option in the Multidrug-Resistant Organism / *Clostridium difficile* Infection (MDRO/CDI) Module for tracking infections through surveillance.
[6]The infection surveillance module does not collect the number of patient admissions; therefore this number is unavailable and a VRE Infection Surveillance Prevalence Rate cannot be calculated.

The VRE inpatient LabID rate increased significantly from 0.8019 to 1.0083 per 1,000 patient days ($p=0.0420$). The VRE prevalence rate also increased significantly from 0.3207 to 0.4689 per 100 admissions ($p=0.0006$). The VRE outpatient LabID rate was 0.0079 per 100 encounters, and the VRE surveillance rate is 0.0252 per 1,000 patient days.

For the first time, a trend graph is available for the VRE LabID rate. It is shown in Figure 10, below.

Figure 10. Michigan VRE LabID Rate Trends



Device-Associated Module Annual Aggregated Rates

Table 14 shows both the Michigan rate and device-utilization (DU) ratio for the CAUTI, CLABSI, and ventilator-associated pneumonia (VAP) modules. It also provides a US comparative rate and DU ratio for each module. As noted in the table, the US comparative rates and ratios were calculated using data from the national estimate from NHSN, according to 2010 NHSN data (this will be updated in future reports). These comparative national rates should be used as a descriptive reference only, and do not necessarily represent the true national rates or ratios.

Table 14.

Michigan Device-Associated Rates

Type of Infection	Number of Hospitals	Number of Infections	Number of Patient Days	Number of Device Days	MI Rate[1]	US Rate[2]	MI DU[3]	US DU[4]
CAUTI[5]	78	964	1,139,283	423,855	2.2744 ↑	1.5113	0.3720 ↑	0.2814
CLABSI[6]	73	296	1,096,079	353,886	0.8364	0.9488	0.3287 ↓	0.2499
VAP[7]	55	117	378,193	107,618	1.0872 ↑	1.3179	0.2846 ↓	0.2983

Michigan Rate **US Comparative Rate**

[1]MI Rates are the number of device-associated infections per 1,000 device days among participating hospitals. ↑: significant rate increase from previous annual report, ↓: significant rate decrease from previous annual report.

[2]The US comparative rates were calculated using data from the national estimate on the National Healthcare Safety Network (NHSN). This is according to 2010 NHSN data (Am J Infect Control 2011;39:798-816). These data are for a descriptive reference only, and do not necessarily represent the true national rate.

[3]DU: Device Utilization. The proportion of days on a device divided by the total number of patient days reported for the unit. The device could be a catheter, central line, or ventilator. The MI DU is the proportion of patient days that are spent using a device.

[4]The US comparative DU was calculated using data from the national estimate on the National Healthcare Safety Network (NHSN). This is according to 2010 NHSN data (Am J Infect Control 2011;39:798-816). These data are for a descriptive reference only, and do not necessarily represent the true national DU ratio.

[5] Catheter-Associated Urinary Tract Infections (CAUTIs) are defined using symptomatic urinary tract infection (SUTI) criteria or Asymptomatic Bacteremic UTI (ABUTI) criteria. UTIs must be catheter-associated (i.e. patient had an indwelling urinary catheter at the time of or within 48 hours before onset of the event).

[6]Central Line-Associated Bloodstream Infections (CLABSIs) are laboratory-confirmed bloodstream infections (LCBI) that are not secondary to a community-acquired infection, or an HAI meeting CDC/NHSN criteria at another body site. BSIs must be central line associated (i.e., a central line or umbilical catheter was in place at the time of, or within 48 hours before, onset of the event).

[7]Ventilator-Associated Pneumonias (VAPs) can be identified by using a combination of radiologic, clinical and laboratory criteria. PNEUs must be ventilator-associated (i.e., patient was intubated and ventilated at the time of or within 48 hours before the onset of the event).

The Michigan CAUTI rate increased significantly this year from 1.0427 to 2.2744 per 1,000 catheter days ($p<0.0001$). This was also significantly greater than the descriptive US rate of 1.5113 per 1,000 catheter days ($p<0.0001$). The Michigan DU ratio increased significantly from 0.2941 to 0.3720 ($p<0.0001$) and was significantly greater than the comparative descriptive US DU ratio of 0.2814 ($p<0.0001$).

Hospitals in Michigan have been working diligently with MHA Keystone to reduce CLABSI rates; this is reflected in the data in Table 14 (above). With data collected from 73 hospitals, Michigan's device utilization ratio is significantly higher than the U.S. ratio (0.3287 and 0.2499, respectively ($p<0.0001$)). However, the Michigan DU ratio significantly decreased from 0.3393 in the last annual report to 0.3287 in the present ($p<0.0001$). The Michigan CLABSI rate of 0.8364 per 1,000 central line days is statistically significantly lower than the national average of 0.9488 per 1,000 central line days ($p=0.0275$), but did not significantly change from the previous report to the present.

The data below indicate that the Michigan VAP rate was 1.0872 per 1,000 ventilator days within the hospitals participating in this module and sharing data with the MDCH SHARP Unit. This rate is statistically significantly lower than the national rate of 1.3179 per 1,000 ventilator days ($p=0.0333$), although it increased significantly from the last annual report rate of 0.7933 per 1,000 ventilator days ($p=0.0441$). The Michigan ventilator DU ratio of 0.2846 is significantly lower than the national average DU ratio of 0.2983 ($p<0.0001$), and it decreased significantly from the previous DU ratio of 0.2966 ($p<0.0001$).

Figures 11 and 12 (below) show device-associated infection rates and DU ratios from 2009-2012.

Figure 11. Device-Associated Infection Rates over time

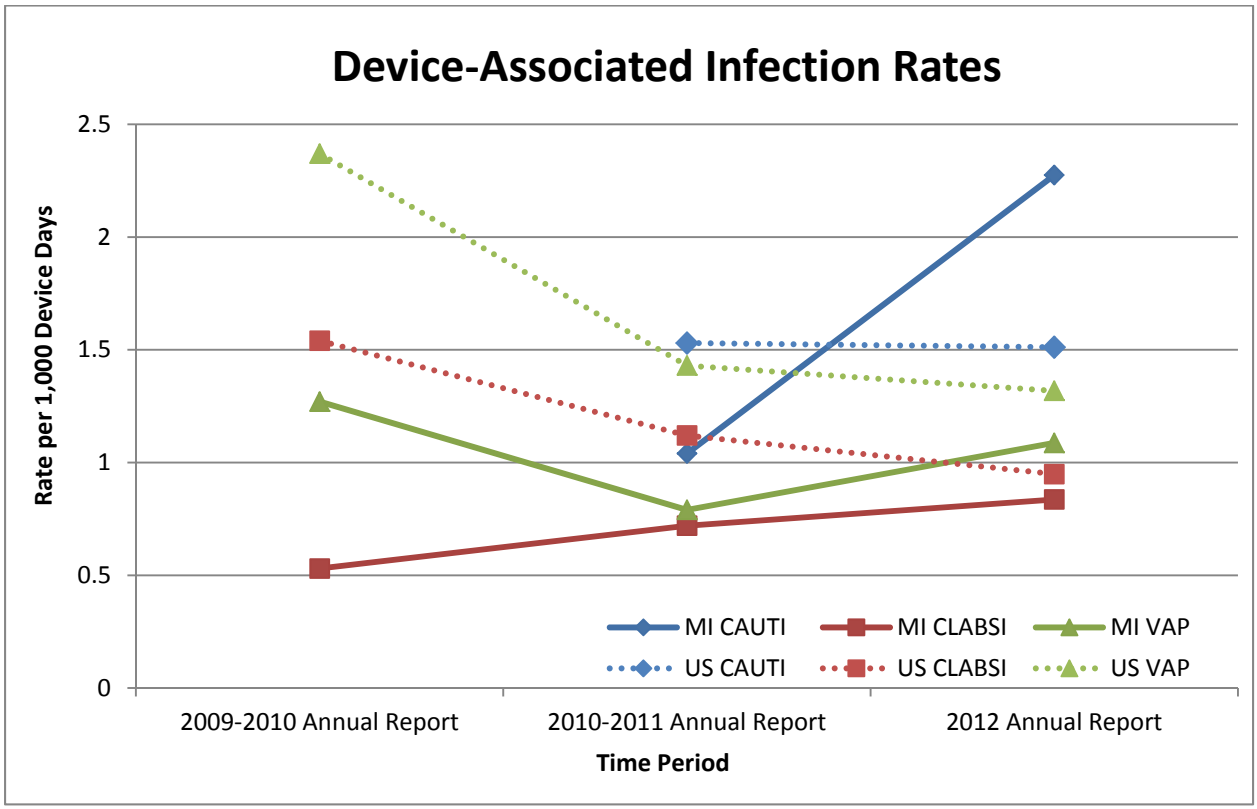


Figure 12. Device Utilization Ratios over time

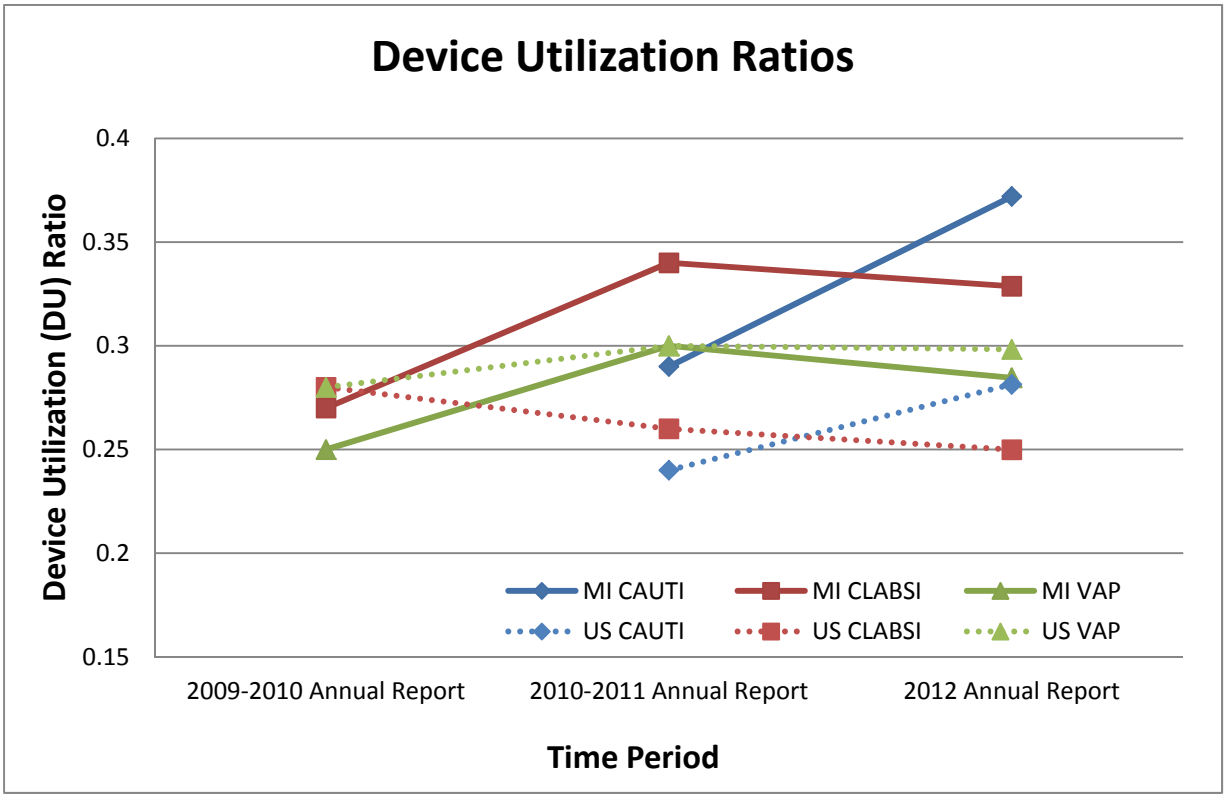


Table 17 provides NICU-specific CLABSI and VAP rates by birth weight. There are up to 16 hospitals sharing CLABSI NICU data, and up to 8 hospitals sharing VAP NICU data (depending on birthweight code). Trend data and significance testing will be made available for NICU-specific CLABSI and VAP rates in future reports.

Table 15.

Michigan NICU Device-Associated Rates by Birth Weight

Type of Infection	Birth weight Code	Number of Hospitals	Number of Infections	Number of Patient Days	Number of Device Days	MI Rate[1]	US Rate[2]	MI DU[3]	US DU[4]
CLABSI[5]	**Overall**	**16**	**38**	**139,852**	**28,243**	**1.3455**	**1.5121**	**0.2019**	**0.2746**
	A[6]	15	13	20,404	6,456	2.0136	2.5720	0.3164	0.4299
	B[7]	16	11	19,144	5,666	1.9414	1.9835	0.2960	0.3730
	C[8]	15	6	30, 785	6,120	0.9804	1.2725	0.1988	0.2822
	D[9]	15	3	39,686	4,826	0.6216	0.8712	0.1216	0.1769
	E[10]	16	5	29,833	5,175	0.9662	0.8183	0.1735	0.2391
VAP[11]	**Overall**	**8**	**2**	**70,607**	**7,649**	**0.2615**	**1.0813**	**0.1083**	**0.1550**
	A	7	1	10,470	3,831	0.2610	1.5757	0.3659	0.3850
	B	8	1	8,103	1,760	0.5682	1.4451	0.2172	0.2229
	C	8	0	16,062	797	0.0000	0.9914	0.0496	0.1059
	D	8	0	21,561	544	0.0000	0.5412	0.0252	0.0667
	E	8	0	14,411	717	0.0000	0.2052	0.0498	0.1237

Michigan Data **US Comparative Data**

[1]MI Rates are the number of device-associated infections per 1,000 device days among participating hospitals.

[2] The US comparative rates were calculated from a pooled mean using data from the national estimate on the National Healthcare Safety Network (NHSN). This is according to 2010 NHSN data (Am J Infect Control 2011;39:798-816). These data are for a descriptive reference only, and do not necessarily represent the true national rate.

[3]DU: Device Utilization. The proportion of days on a device over the total number of patient days reported for the unit. The device could be a catheter, central line, or ventilator. The MI DU is the proportion of patient days that are spent using a device.

[4]The US comparative DU was calculated using data from the national estimate on the National Healthcare Safety Network (NHSN). This is according to 2010 NHSN data (Am J Infect Control 2011;39:798-816).

[5]Central Line-Associated Bloodstream Infections (CLABSIs) are laboratory-confirmed bloodstream infections (LCBI) that are not secondary to a community-acquired infection, or an HAI meeting CDC/NHSN criteria at another body site. BSIs must be central line associated (i.e., a central line or umbilical catheter was in place at the time of, or within 48 hours before, onset of the event).

[6]A: Birthweight ≤750g

[7]B: Birthweight 751 – 1000g

[8]C: Birthweight 1001 – 1500g

[9]D: Birthweight 1501 – 2500g

[10]E: Birthweight >2500g

[11]Ventilator-Associated Pneumonias (VAPs) can be identified by using a combination of radiologic, clinical and laboratory criteria. PNEUs must be ventilator-associated (i.e., patient was intubated and ventilated at the time of, or within 48 hours before, the onset of the event).

Device-Associated Standardized Infection Ratios (SIRs)

The 2012 device-associated standardized infection ratios (SIRs) are shown in Table 16 (below). The table shows the number of observed and predicted infections for both CAUTI and CLABSIs. In the future, the US SIR will be added to this report upon CDC's release of these data (expected April 2014). Note: these SIRs included all device data reported, and are not limited to the locations included in CMS reporting.

Table 16.

Device Standardized Infection Ratios (SIR)

Type of Infection	Number Hospitals	Device Days	Observed[1]	Predicted[2]	MI SIR[3]	MI SIR p-value[4]	MI 95% CI[5]	US SIR[6]	US 95% CI[7]
CAUTI[8]	78	387,698	933	825.503	1.130 ↑	0.0001	1.059, 1.205	TBA	TBA
CLABSI[9]	75	360,333	329	722.746	0.455	<0.0001	0.407, 0.507	TBA	TBA

Michigan Data **US Data**

Highlight: Indicates significantly fewer infections than expected

Highlight: Indicates significantly more infections than expected

[1]Observed: Number of infections (CAUTI or CLABSIs) reported during the time frame.

[2]Predicted: The number of CAUTIs or CLABSIs predicted based on the type of hospital unit(s) under surveillance.

[3]SIR: Standardized Infection Ratio: Ratio of observed events compared to the number of predicted events, accounting for unit type or procedure. An SIR of 1 can be interpreted as having the same number of events that were predicted. An SIR that is between 0 and 1 represents **fewer** events than predicted, while an SIR of greater than 1 represents **more** events than expected. ↑: significant SIR increase from previous annual report, ↓: significant SIR decrease from previous annual report.

[4]P-value: An SIR p-value of <0.05 is considered significantly different than expected. It can show either significantly more infections (if the SIR is greater than 1 and the p-value is <0.05) or significantly fewer infections (if the SIR is less than 1 and the p-value is <0.05).

[5]95% CI: 95% confidence interval around the SIR estimate. A 95% CI indicates that 95% of the time, the actual SIR will fall within this interval.

[6]US SIR taken from the National and State Healthcare-Associated Infections Standardized Infection Ratio Report, January-December 2012

[7]US 95% CI taken from the Nation and State Healthcare-Associated Infections Standardized Infection Ratio Report, January-December 2012

[8]CAUTI: Catheter-Associated Urinary Tract Infection

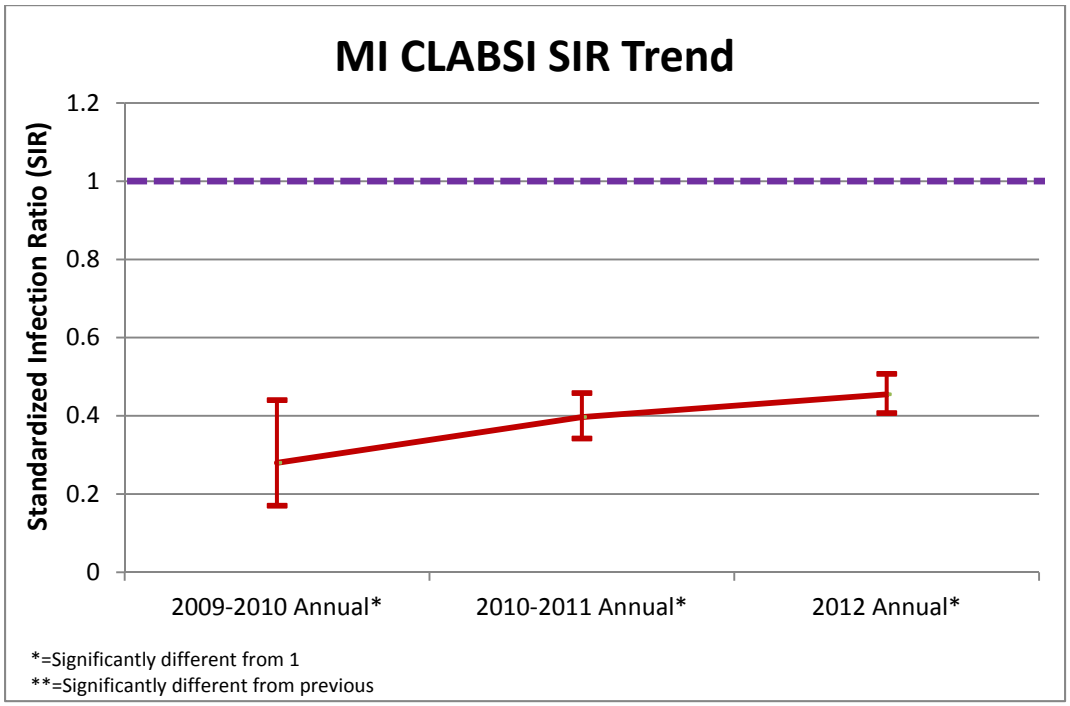
[9]CLABSI: Central Line-Associated Blood Stream Infection

Michigan's CAUTI SIR was 1.130 for 78 participating hospitals. This SIR can be interpreted as having thirteen percent more of CAUTIs than expected, as determined by national NHSN data. This SIR also indicated significantly more infections than the 2010-2011 Annual Report CAUTI SIR of 0.638 ($p<0.0001$). A trend figure will be made available on the next report, when three annual CAUTI SIRs have been calculated.

Michigan's CLABSI SIR, using data from 75 participating hospitals, was 0.455. This SIR can be interpreted as Michigan having 54.5% fewer CLABSIs than expected, as determined by national NHSN data. This is statistically significantly lower than the expected value. It is not statistically

significantly different than the previous annual report's SIR of 0.397. Figure 13 (below) show the CLABSI SIR trends from the 2009-2010 Annual Report to the present 2012 Annual Report.

Figure 13. Michigan CLABSI SIR Trends



Procedure-Associated Module Aggregated Data

Table 19 shows the SSI infection rates and SIRs by procedure type for the time period included. Only procedure types for which five or more hospitals provided data were included in the present report. Beginning January 1, 2012, hospitals were required by CMS to reports all colon surgery (COLO) and abdominal hysterectomy (HYST) procedures through NHSN. SSI rates and SIRs shown in italics were evaluated for statistically significant difference from the 2010-2011 Annual Report. Rates and SIRs were not available for all procedures in the 2010-2011 Annual Report. It should also be noted that rates are taken from the rate table calculation within NHSN and may not match the numbers in the SIR exactly.

Table 17.

SSI Rates and SIR by Procedure Type

Procedure Type	Number of Hospitals	Number of Procedures	Number of Observed[1] SSIs	Number of Expected[2] SSIs	MI SSI Rate[3]	MI SSI SIR[4]	MI SIR p-value[5]	MI SIR 95% Confidence Interval[6]
Overall	**75**	**44845**	**982**	**1053.793**	***2.1190***	***0.932*** ↓	**0.0133**	**0.873, 0.993**
APPY[7]	8	517	10	10.476	1.6051	0.955	0.5237	0.458, 1.755
BRST[8]	7	472	14	5.774	2.0029	2.425	0.0026	1.326, 4.068
CARD[9]	5	596	6	6.386	1.0033	0.940	0.5446	0.345, 2.045
CBGB[10]	9	1428	23	32.247	*2.2656*	0.713	0.0561	0.452, 1.070
CBGC[11]	9	117	3	2.413	*2.5210*	1.243	0.4337	0.256, 3.633
CHOL[12]	7	990	5	6.133	0.3610	0.815	0.4246	0.265, 1.903
COLO[13]	73	8741	430	513.209	*4.8994* ↓	0.838	0.0001	0.761, 0.921
FUSN[14]	7	2176	41	33.353	*1.9811*	1.229	0.1102	0.882, 1.668
FX[15]	8	837	14	13.666	1.4737	1.024	0.4998	0.560, 1.719
GAST[16]	6	764	7	15.114	0.6616	0.463	0.0169	0.186, 0.954
HER[17]	8	1347	18	15.718	*1.1547* ↓	1.145	0.3143	0.678, 1.810
HPRO[18]	25	5133	80	69.189	*1.5670*	1.156	0.1093	0.917, 1.439
HYST[19]	70	7807	155	148.979	*1.8731*	1.040	0.3216	0.883, 1.218
KPRO[20]	25	7411	67	69.787	*0.9059*	0.960	0.3993	0.744, 1.219
LAM[21]	6	1893	40	18.207	*2.0287*	2.197	<0.0001	1.569, 2.992
OVRY[22]	5	152	3	0.716	1.8939	----	----	----, ----
PVBY[23]	5	297	10	20.305	3.7975	0.492	0.0092	0.236, 0.906
SB[24]	6	279	20	12.581	7.7465	1.590	0.0324	0.971, 2.455
VHYS[25]	11	377	5	3.910	*1.3592*	1.279	0.3536	0.415, 2.984

XLAP[26]	5	441	3	6.739	0.5348	0.445	0.0964	0.092, 1.301

US Data **Michigan Data**

Highlight: Indicates significantly fewer infections than expected

Highlight: Indicates significantly more infections than expected

[1]Observed: Number of SSIs reported during the time frame.

[2]Predicted: The number of SSIs predicted for the same number and type of procedures performed based upon 2009 national SSI rates by procedure type.

[3]MI SSI Rate is the number of SSIs per 100 procedures among participating hospitals. This number is taken from the rate table calculation within NHSN and may not match the numbers in the SIR exactly. ↑: significant rate increase from previous annual report, ↓: significant rate decrease from previous annual report. Rates shown in italics were evaluated for statistically significant difference from the 2010-2011 Annual Report. Rates were not available for all procedures in the 2010-2011 Annual Report.

[4]SIR: Standardized Infection Ratio: Ratio of observed events compared to the number of predicted events, accounting for unit type or procedure. An SIR of 1 can be interpreted as having the same number of events that were predicted. An SIR that is between 0 and 1 represents **fewer** events than predicted, while an SIR of greater than 1 represents **more** events than expected. SIRs with significant p-values are highlighted in either green (significantly better than expected) or red (significantly worse). ↑: significant SIR increase from previous annual report, ↓: significant SIR decrease from previous annual report. SIRs shown in italics were evaluated for statistically significant difference from the 2010-2011 Annual Report. SIRs were not available for all procedures in the 2010-2011 Annual Report.

[5]P-value: An SIR p-value of <0.05 is considered significantly different than expected. It can show either significantly more infections (if the SIR is greater than 1 and the p-value is <0.05) or significantly fewer (if the SIR is less than 1 and the p-value is <0.05).

[6]95% CI: 95% confidence interval around the SIR estimate. A 95% CI indicates that 95% of the time, the actual SIR will fall within this interval.

[7]APPY: Appendix surgery

[8]BRST: Breast surgery

[9]CARD: Cardiac surgery

[10] CBGB: Coronary artery bypass graft with both chest and donor site incisions

[11]CBGC: Coronary artery bypass graft with chest incision only

[12]CHOL: Gallbladder surgery

[13]COLO: Colon surgery

[14]FUSN: Spinal fusion

[15]FX: Open reduction of fracture

[16]GAST: Gastric surgery

[17]HER: Herniorrhaphy

[18]HPRO: Hip prosthesis

[19]HYST: Abdominal hysterectomy

[20]KPRO: Knee prosthesis

[21]LAM: Laminectomy

[22]OVRY: Ovarian Surgery

[23]PVBY: Peripheral vascular bypass surgery

[24]SB: Small Bowel Surgery

[25]VHYS: Vaginal hysterectomy

[26]XLAP: Abdominal surgery

The Overall SSI SIR was 0.932 (95% CI: 0.873, 0.993), which demonstrated significantly fewer infections than expected. This was also a significant decrease from the last annual report SIR of 1.187 ($p<0.0001$). The colon surgery (COLO) SSI rate significantly decreased from 7.7088 to 4.8994 per 100 procedures ($p=0.0010$), and the herniorrhaphy (HER) SSI rate significantly decreased from 4.1558 to 1.1547 per 100 procedures ($p=0.0004$). No other tested rate changes were found to be significant.

Cumulative Rates and SIRs Aggregated by Specifiers

MRSA and CDI LabID rates were calculated on an aggregate level by hospital type (teaching or non-teaching), region group (based on Michigan emergency preparedness region), and bed size (≤200 beds or >200 beds). Device rates and CAUTI and CLABSI SIRs were also calculated. Rates and SIRs were provided when 5 or more hospitals shared data for that particular module.

Table 18.

MDRO Rates[1] by Hospital Type

Hospital Type	MDRO Infection Type (number of hospitals)	Rate	CO Rate[2] (%CO)
Teaching	**MRSA LabID[3] (22)**	1.8491	1.2833 (69)
	CDI LabID[4] (28)	18.4168	7.1248 (39)
Non-Teaching	**MRSA LabID (22)**	2.3528	1.9439 (83)
	CDI LabID (24)	19.2400	9.2626 (48)

Michigan Data

[1]Rates were calculated using the number of infections/events per 1,000 (or per 10,000 for CDI) patient days or device days according to the same MI rate shown in Tables 9–14 among hospitals that shared data with MDCH SHARP through the NHSN.
[2]CO Rate: Community Onset Rate, (%CO): Percent of LabID events that were community onset
[3]MRSA LabID: Methicillin-Resistant *Staphylococcus aureus* (MRSA) Laboratory-identified (LabID) Event option within the Multidrug-Resistant Organism / *Clostridium difficile* Infection (MDRO/CDI) Module of NHSN for tracking MRSA laboratory results without conducting additional surveillance for infections.
[4] CDI LabID: *Clostridium difficile (C. diff)* Infection (CDI) LabID Event option within the MDRO/CDI Module of NHSN for tracking CDI laboratory results without conducting additional surveillance for infections.

Non-teaching hospitals had higher MRSA Rates than teaching hospitals; they also had a higher percentage of community-onset MRSA LabID events. MRSA LabID Rates decreased from the previous report for teaching hospitals, but increased in non-teaching hospitals (see Figures 14 and 15).

Non-Teaching hospitals had a higher rate of CDI LabID events than teaching hospitals, as well as a higher community-onset rate. From the 2010-2011 Annual Report to the present report, CDI LabID Event rates increased for both teaching and non-teaching hospitals (see Figures 14 and 15).

Figure 14. MDRO/CDI Rate Trends for Teaching Hospitals

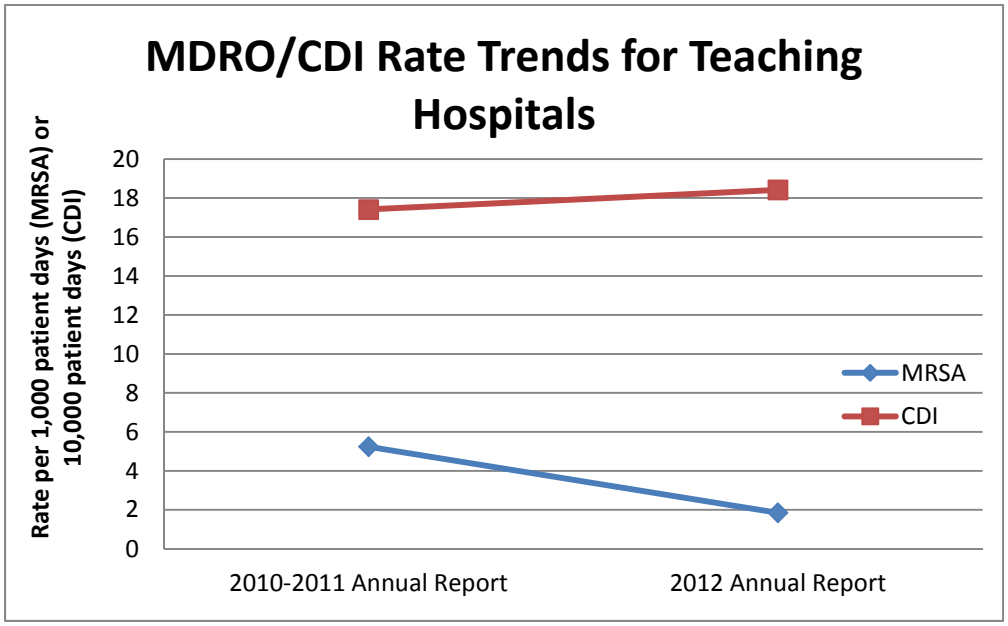


Figure 15. MDRO/CDI Rate Trends for Non-Teaching Hospitals

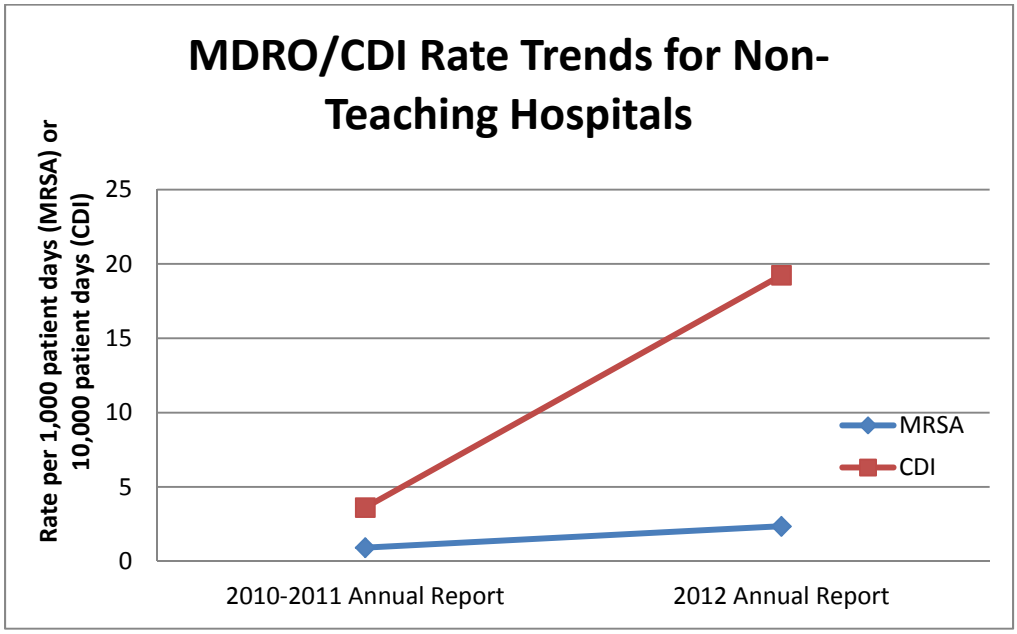


Table 19.

Device Rates[1] and SIR by Hospital Type

Hospital Type	Device-Associated Infection	Rate (Number of Hospitals)	US Rate[2]	SIR[3]	SIR p-value[4]	SIR 95% Confidence Interval[5]
Teaching	CAUTI[6]	2.1198 (43)	1.6253	1.183	<0.0001	1.106, 1.265
	CLABSI[7]	0.8738 (42)	0.9828	0.461	<0.0001	0.411, 0.516
	VAP[8]	1.0218 (31)	1.4346	-----	-----	-----
Non-Teaching	CAUTI	2.6897 (35)	1.3532	0.735	0.0038	0.574, 0.927
	CLABSI	0.5634 (31)	0.8973	0.372	<0.0001	0.233, 0.563
	VAP	1.5019 (24)	1.0830	-----	-----	-----

US Data **Michigan Data**

Highlight: Indicates significantly fewer infections than expected

Highlight: Indicates significantly more infections than expected

[1]Rates were calculated using the number of infections/events per 1,000 device days according to the same MI rate shown in Tables 9-14 among hospitals that shared data with MDCH SHARP through the NHSN.

[2] The US comparative rates were calculated from a pooled mean using data from the national estimate on the National Healthcare Safety Network (NHSN). This is according to 2010 NHSN data (Am J Infect Control 2011;39:798-816). These data are for a descriptive reference only, and do not necessarily represent the true national rate. Each rate is individually matched to the Michigan data by facility type and unit type, then aggregated into an overall rate.

[3]SIR: Standardized Infection Ratio: Ratio of observed events compared to the number of predicted events, accounting for unit type or procedure. An SIR of 1 can be interpreted as having the same number of events that were predicted. An SIR that is between 0 and 1 represents **fewer** events than predicted, while an SIR of greater than 1 represents **more** events than expected.

[4]P-value: An SIR p-value of <0.05 is considered significantly different than expected. It can show either significantly more infections (if the SIR is greater than 1 and the p-value is <0.05) or significantly fewer (if the SIR is less than 1 and the p-value is <0.05).

[5]95% CI: 95% confidence interval around the SIR estimate. A 95% CI indicates that 95% of the time, the actual SIR will fall within this interval.

[6]CAUTI: Catheter-Associated Urinary Tract Infection

[7]CLABSI: Central Line-Associated Blood Stream Infection

[8]VAP: Ventilator-Associated Pneumonia

Michigan teaching hospitals observed a significantly higher number of CAUTIs than expected with an SIR of 1.183 (95% CI: 1.106, 1.265), while non-teaching hospitals observed significantly fewer CAUTIs than expected with an SIR of 0.735 (0.574, 0.927) (see Figures 16 and 17). Both teaching and non-teaching hospitals observed significantly fewer CLABSIs than expected with SIRs of 0.461 (0.411, 0.516) and 0.372 (0.233, 0.563), respectively.

With the exception of CAUTI rates, device rates for both teaching and non-teaching hospitals remained fairly stable from the previous annual report to the present (see Figures 16 and 17, below).

Figure 16. Device Rate Trends for Teaching Hospitals

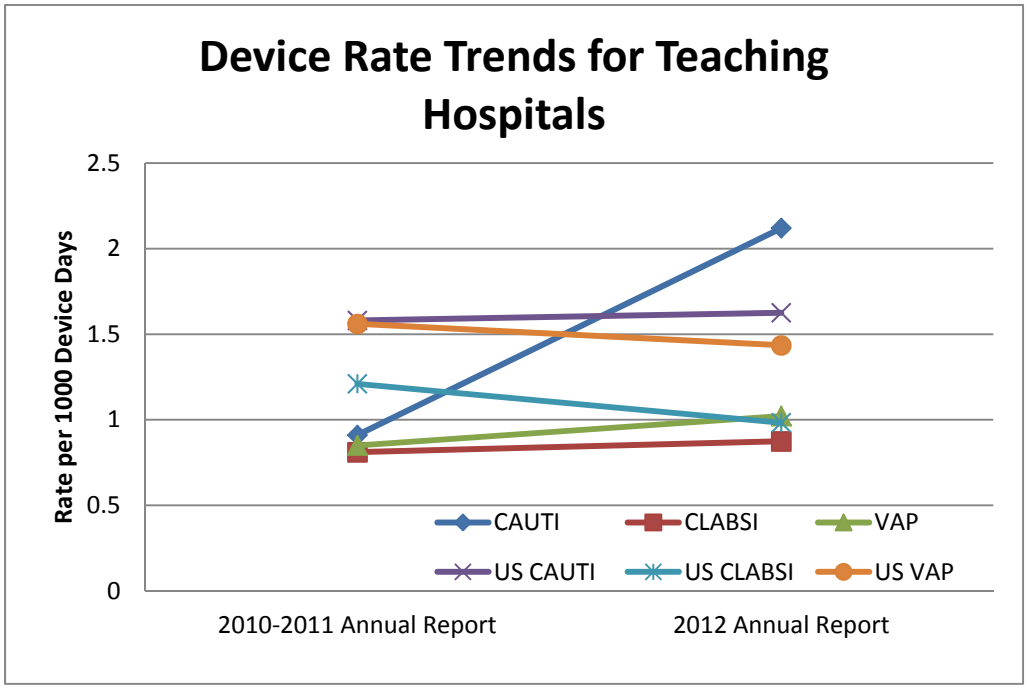


Figure 17. Device Rate Trends for Non-Teaching Hospitals

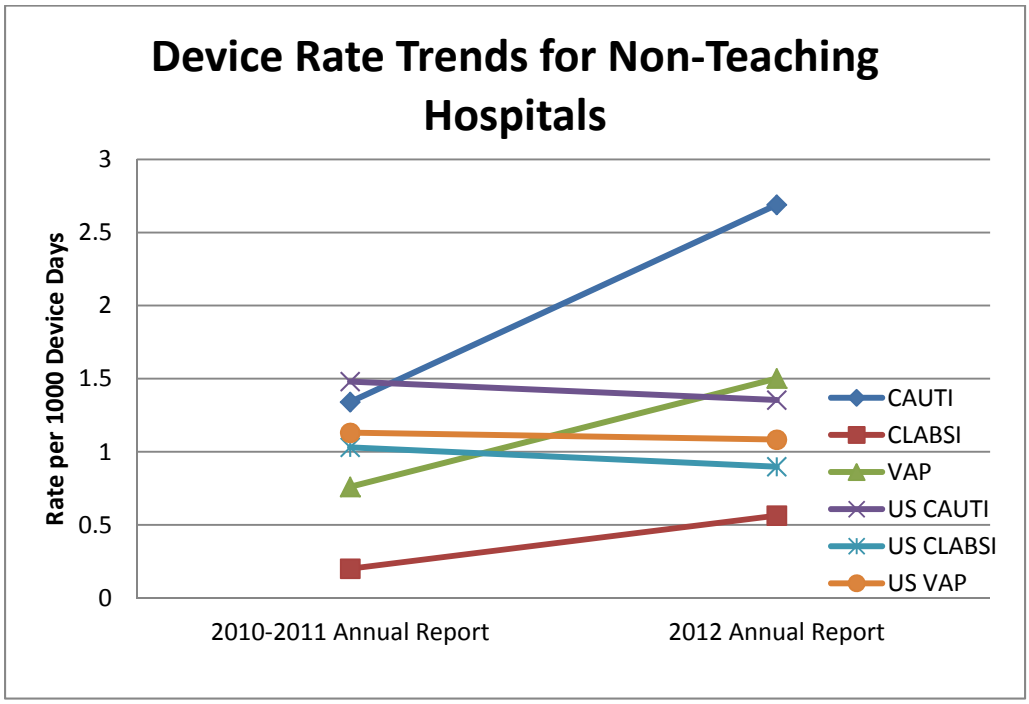


Table 20.

MDRO Rates[1] by Michigan Region

Michigan Region	MDRO Infection Type (Number of Hospitals)	Rate	CO Rate[2] (%CO)
Group 1 (Regions 1, 2N, 2S)	**MRSA LabID[3] (16)**	2.3928	1.6322 (70)
	CDI LabID[4] (20)	20.9644	7.9176 (38)
Group 2 (Regions 3, 5, 6)	**MRSA LabID (22)**	1.6040	1.2210 (76)
	CDI LabID (25)	15.3370	6.8291 (45)
Group 3 (Regions 7, 8)	**MRSA LabID (7)**	0.9313	0.7620 (82)
	CDI LabID (8)	13.6051	7.9363 (58)

Michigan Data

[1]Rates were calculated using the number of infections/events per 1,000 (or per 10,000 for CDI) patient days or device days according to the same MI rate shown in Tables 9–14 among hospitals that shared data with MDCH SHARP through the NHSN.
[2]CO Rate: Community Onset Rate, (%CO): Percent of LabID events that were community onset
[3]MRSA LabID: Methicillin-Resistant *Staphylococcus aureus* (MRSA) Laboratory-identified (LabID) Event option within the Multidrug-Resistant Organism / *Clostridium difficile* Infection (MDRO/CDI) Module of NHSN for tracking MRSA laboratory results without conducting additional surveillance for infections.
[4] CDI LabID: *Clostridium difficile (C. diff)* Infection (CDI) LabID Event option within the MDRO/CDI Module of NHSN for tracking CDI laboratory results without conducting additional surveillance for infections.

Group 1 (previously titled Southeast Michigan) had the highest MRSA LabID rate; however, this regional group had the lowest percentage of CO events while Group 3 (previously titled Northern Michigan) had the lowest rate of MRSA LabID events and the highest percentage of CO. MRSA LabID rates decreased from the previous annual report for both Group 1 and Group 2 (formerly titled Mid/Western Michigan). There were not enough data to calculate a trend for Group 3 (see Figures 18 and 19).

Group 1 also had the highest CDI LabID rate and the lowest percentage of CO events while Group 3 had the lowest CDI LabID rate and the highest percentage of CO events. From the previous annual report to the present, CDI LabID event rates increased for both Groups 1 and 2. There were not enough data to calculate a trend for Group 3 (see Figures 18 and 19).

Figure 17. MDRO/CDI Rate Trends for Group 1 (Regions 1, 2N, 2S) Hospitals

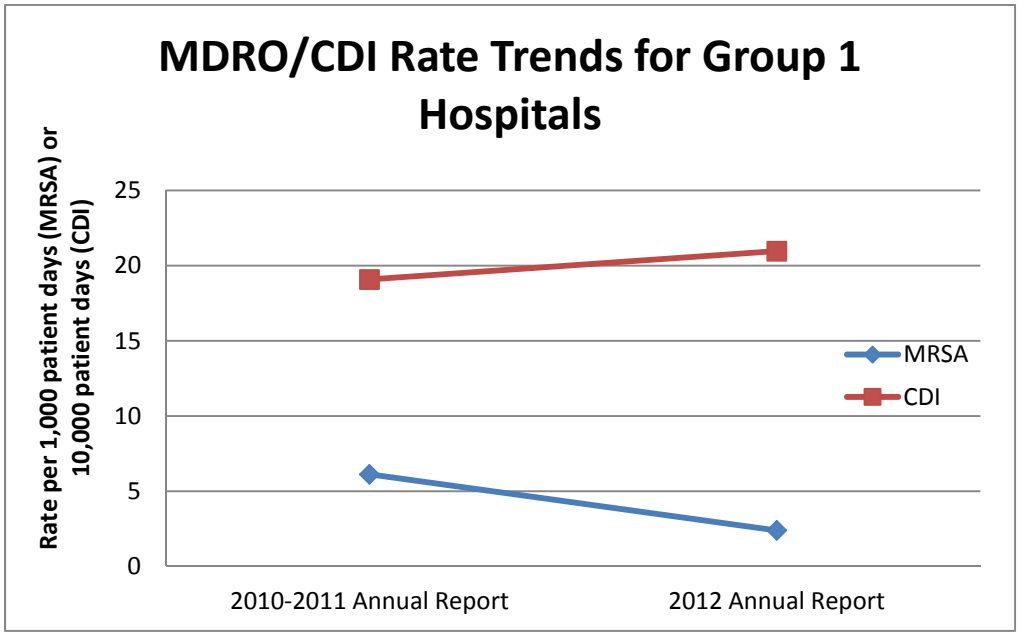


Figure 18. MDRO/CDI Rate Trends for Group 2 (Regions 3, 5, 6) Hospitals

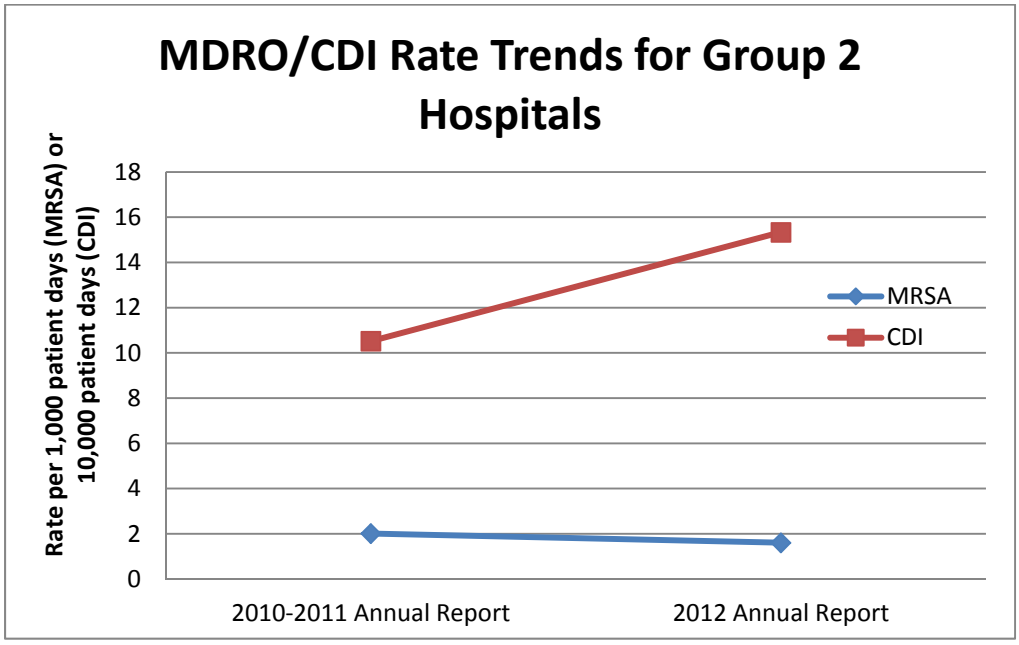


Table 21.

Device Rates[1] and SIR by Michigan Region

Region	Device-Associated Infection	Rate (Number of hospitals)	US Rate[2]	SIR[3]	SIR p-value[4]	SIR 95% Confidence Interval[5]
Region Group 1 (Regions 1, 2N, 2S)	**CAUTI[6]**	2.4718 (31)	1.6247	1.041	0.1791	0.956, 1.131
	CLABSI[7]	0.8896 (30)	0.9732	0.447	<0.0001	0.387, 0.513
	VAP[8]	0.8987 (23)	1.4399	-----	-----	-----
Region Group 2 (Regions 3, 5, 6)	**CAUTI**	2.1805 (35)	1.4722	1.404	<0.0001	1.263, 1.556
	CLABSI	0.7785 (32)	0.9450	0.479	<0.0001	0.397, 0.572
	VAP	1.7164 (22)	1.2475	-----	-----	-----
Region Group 3 (Regions 7, 8)	**CAUTI**	1.9858 (12)	1.3465	0.795	0.0994	0.550, 1.111
	CLABSI	0.6568 (11)	0.8917	0.366	<0.0001	0.176, 0.674
	VAP	0.1506 (10)	1.1383	-----	-----	-----

US Data **Michigan Data**

Highlight: Indicates significantly fewer infections than expected

Highlight: Indicates significantly more infections than expected

[1]Rates were calculated using the number of infections/events per 1,000 device days according to the same MI rate shown in Tables 9-14 among hospitals that shared data with MDCH SHARP through the NHSN.

[2] The US comparative rates were calculated from a pooled mean using data from the national estimate on the National Healthcare Safety Network (NHSN). This is according to 2010 NHSN data (Am J Infect Control 2011;39:798-816). These data are for a descriptive reference only, and do not necessarily represent the true national rate. Each rate is individually matched to the Michigan data by facility type and unit type, then aggregated into an overall rate.

[3]SIR: Standardized Infection Ratio: Ratio of observed events compared to the number of predicted events, accounting for unit type or procedure. An SIR of 1 can be interpreted as having the same number of events that were predicted. An SIR that is between 0 and 1 represents **fewer** events than predicted, while an SIR of greater than 1 represents **more** events than expected.

[4]P-value: An SIR p-value of <0.05 is considered significantly different than expected. It can show either significantly more infections (if the SIR is greater than 1 and the p-value is <0.05) or significantly fewer (if the SIR is less than 1 and the p-value is <0.05).

[5]95% CI: 95% confidence interval around the SIR estimate. A 95% CI indicates that 95% of the time, the actual SIR will fall within this interval.

[6]CAUTI: Catheter-Associated Urinary Tract Infection

[7]CLABSI: Central Line-Associated Blood Stream Infection

[8]VAP: Ventilator-Associated Pneumonia

CAUTI SIRs indicated that there were more infections than expected for Groups 1 and 2; Group 2 experienced significantly more infections than expected. The CAUTI SIR for Group 3 indicated that there were fewer infections than expected, although this was not statistically significant. All three groups experienced significantly fewer CLABSI infections than expected, according to their SIR.

Group 1 had the highest rate for all three infection types (CAUTI, CLABSI, and VAP). With the exception of the MI CAUTI Rate, which increased, all rates remained fairly stable from the previous annual report

to the present for Group 1; similarly, most rates for Group 2 remained stable with the exception of the MI CAUTI and MI VAP rates, which increased (see Figures 20 and 21).

Figure 20. Device Rate Trends for Group 1 (Regions 1, 2N, 2S) Hospitals

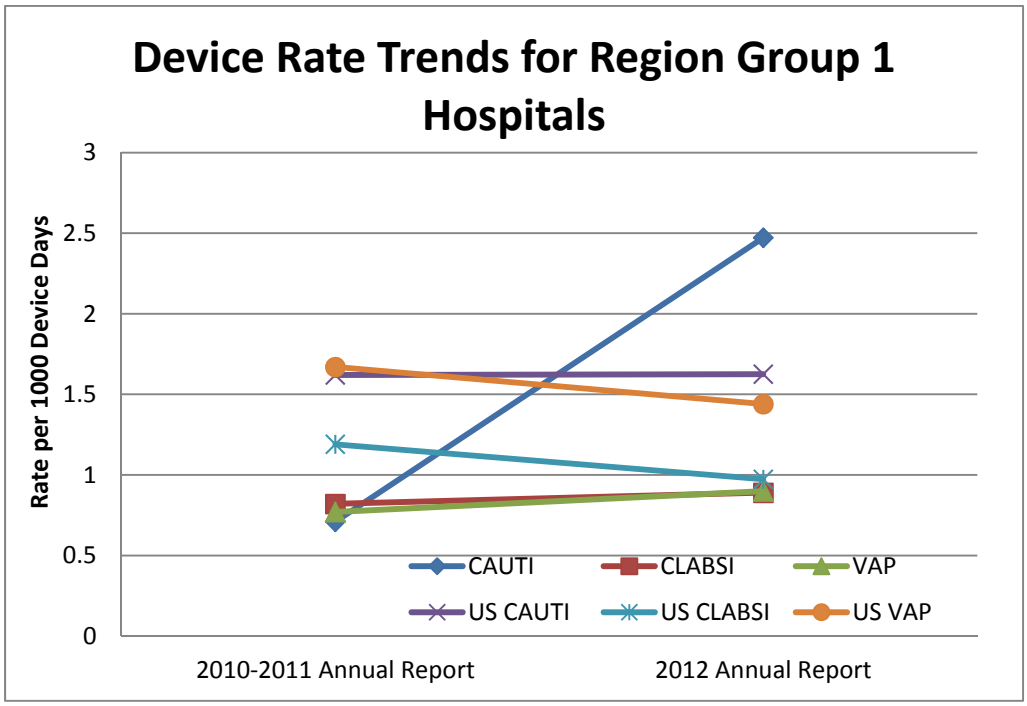


Figure 21. Device Rate Trends for Group 2 (Regions 3, 5, 6) Hospitals

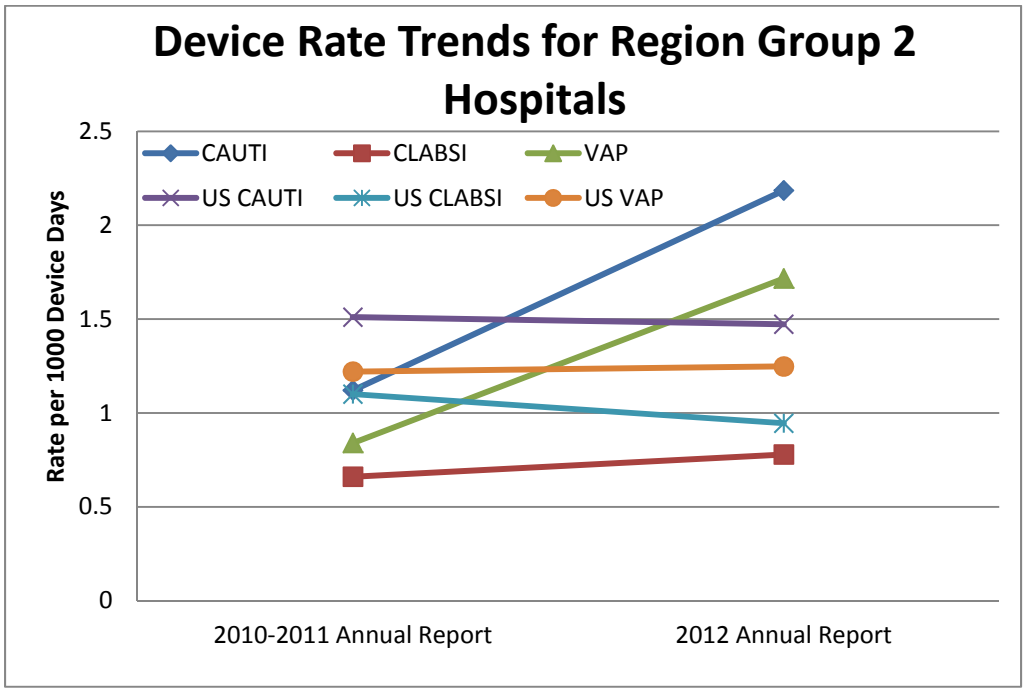


Table 22.

MDRO Rates[1] by Hospital Bed Size

Bed Size	MDRO Infection Type (Number of Hospitals)	Rate	CO Rate[2] (%CO)
≤200 Beds	**MRSA LabID[3] (26)**	2.0080	1.6639 (83)
	CDI LabID[4] (29)	18.3484	9.3751 (51)
>200 Beds	**MRSA LabID[3] (19)**	1.9071	1.3394 (70)
	CDI LabID[4] (24)	18.4023	7.0677 (38)

Michigan Data

[1]Rates were calculated using the number of infections/events per 1,000 (or per 10,000 for CDI) patient days or device days according to the same MI rate shown in Tables 9–14 among hospitals that shared data with MDCH SHARP through the NHSN.
[2]CO: Community Onset (%CO: Percent of LabID events that were community onset)
[3]MRSA LabID: Methicillin-Resistant *Staphylococcus aureus* (MRSA) Laboratory-identified (LabID) Event option within the Multidrug-Resistant Organism / *Clostridium difficile* Infection (MDRO/CDI) Module of NHSN for tracking MRSA laboratory results without conducting additional surveillance for infections.
[4]CDI LabID: *Clostridium difficile (C. diff)* Infection (CDI) LabID Event option within the MDRO/CDI Module of NHSN for tracking CDI laboratory results without conducting additional surveillance for infections.

Hospitals with 200 beds or less experienced a slightly higher MRSA LabID rate than those with greater than 200 beds. Smaller hospitals also had a higher percentage of CO MRSA LabID events. From the previous annual report to the present, MRSA LabID event rates remained fairly stable for both smaller and larger hospitals (Figures 22 and 23).

Hospitals with 200 beds or less had slightly lower CDI LabID event rates than those with greater than 200 beds. They also had more community-onset CDI LabID events. From the previous annual report to the present, both small and large hospitals experienced an increase in CDI LabID Rates (Figures 21 and 22)

Figure 22. MDRO/CDI Rate Trends for ≤200 Beds

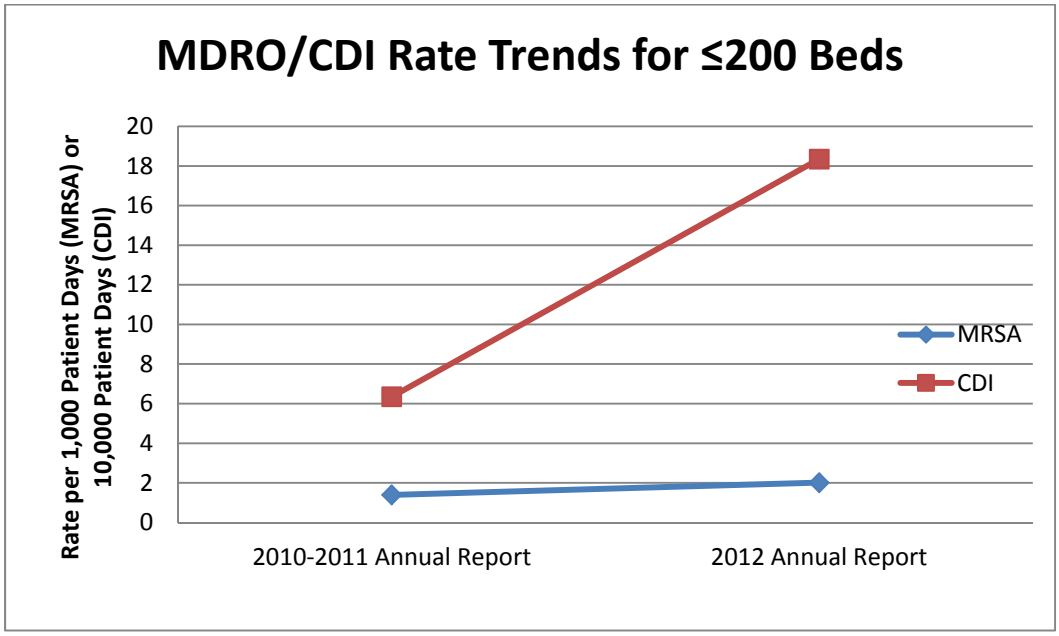


Figure 23. MDRO/CDI Rate Trends for >200 Beds

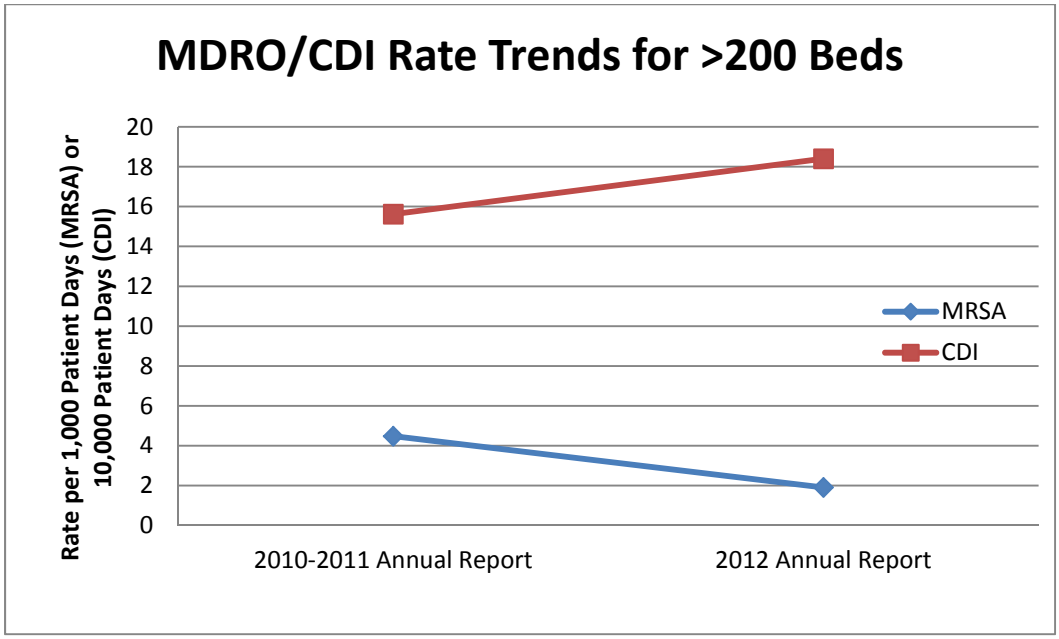


Table 23.

Device Rates[1] and SIR by Hospital Bed Size

Bed Size	Device-Associated Infection	Rate (Number of Hospitals)	US Rate[2]	SIR[3]	SIR p-value[4]	SIR 95% Confidence Interval[5]
≤200 Beds	CAUTI[6]	1.7502 (41)	1.3600	0.996	0.3895	0.784, 1.177
	CLABSI[7]	0.5936 (35)	0.8990	0.373	<0.0001	0.234, 0.565
	VAP[8]	1.0829 (27)	1.2573	-----	-----	-----
>200 Beds	CAUTI	2.5344 (37)	1.6497	1.150	<0.0001	1.074, 1.231
	CLABSI	0.8648 (37)	0.9913	0.461	<0.0001	0.411, 0.516
	VAP	1.0877 (28)	1.3503	-----	-----	-----

US Data **Michigan Data**

Highlight: Indicates significantly fewer infections than expected

Highlight: Indicates significantly more infections than expected

[1]Rates were calculated using the number of infections/events per 1,000 patient days or device days according to the same MI rate shown in Tables 9–14 among hospitals that shared data with MDCH SHARP through the NHSN.

[2] The US comparative rates were calculated from a pooled mean using data from the national estimate on the National Healthcare Safety Network (NHSN). This is according to 2010 NHSN data (Am J Infect Control 2011;39:798-816). These data are for a descriptive reference only, and do not necessarily represent the true national rate. Each rate is individually matched to the Michigan data by facility type and unit type, then aggregated into an overall rate.

[3]SIR: Standardized Infection Ratio: Ratio of observed events compared to the number of predicted events, accounting for unit type or procedure. An SIR of 1 can be interpreted as having the same number of events that were predicted. An SIR that is between 0 and 1 represents **fewer** events than predicted, while an SIR of greater than 1 represents **more** events than expected.

[4]P-value: An SIR p-value of <0.05 is considered significantly different than expected. It can show either significantly more infections (if the SIR is greater than 1 and the p-value is <0.05) or significantly fewer (if the SIR is less than 1 and the p-value is <0.05).

[5]95% CI: 95% confidence interval around the SIR estimate. A 95% CI indicates that 95% of the time, the actual SIR will fall within this interval.

[6]CAUTI: Catheter-Associated Urinary Tract Infection

[7]CLABSI: Central Line-Associated Blood Stream Infection

[8]VAP: Ventilator-Associated Pneumonia

Hospitals with 200 beds or less had a CAUTI SIR of 0.996, which indicates that they had slightly fewer infections than expected. It was not statistically significant, though. Hospitals with greater than 200 beds had significantly more observed infections than expected (SIR=1.150, 95% CI: 1.074, 1.231).

Both smaller and larger hospitals had statistically significantly fewer CLABSI infections than expected, with SIRs of 0.373 (0.234, 0.565) and 0.461 (0.411, 0.516), respectively.

From the previous annual report to the present, rates for smaller hospitals remained fairly stable, although many rates demonstrated a slight increase. Rates for larger hospitals also remained stable, with the exception of Michigan CAUTIs, which increased substantially (see Figures 24 and 25).

Figure 24. Device Rate Trends ≤200 Beds

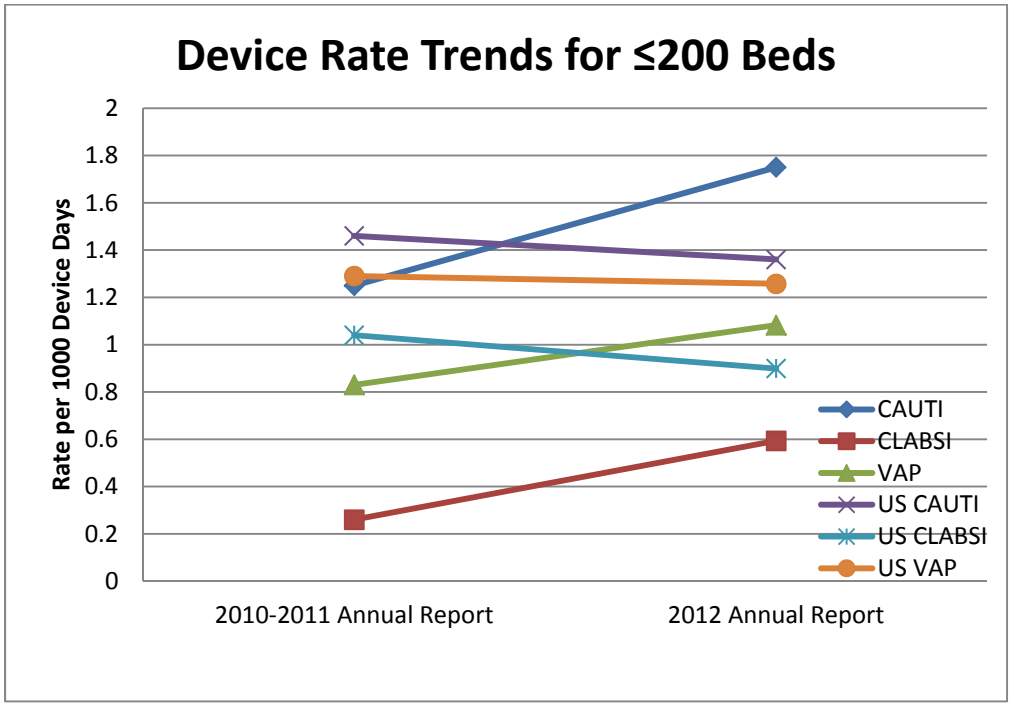
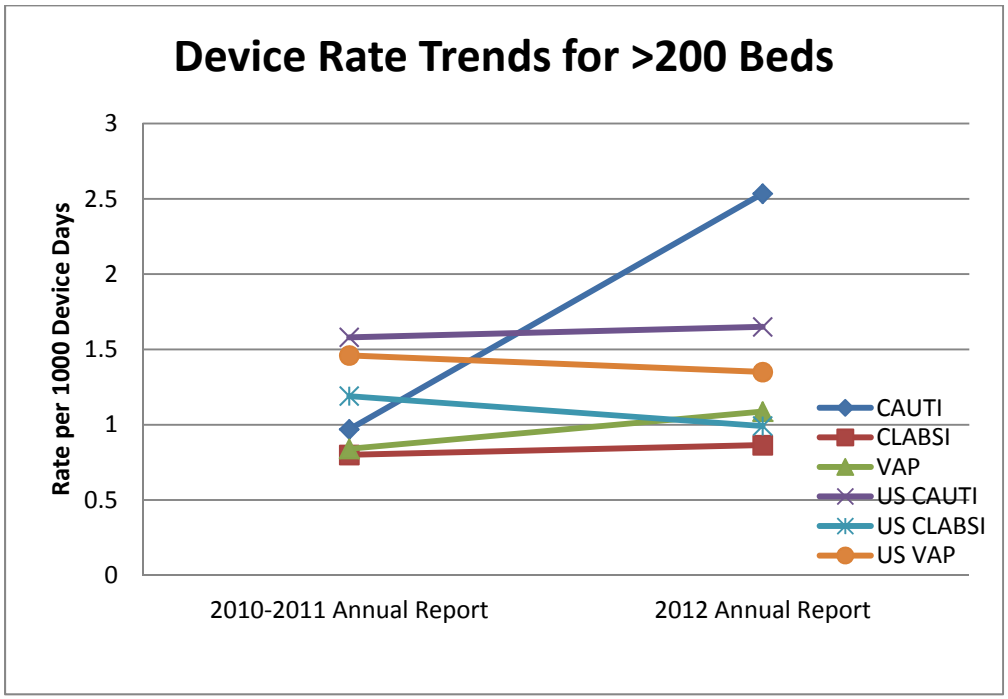


Figure 25. Device Rate Trends >200 Beds



Conclusions

HAIs continue to occur in Michigan healthcare facilities and throughout the U.S. Although the numbers and rates of CLABSIs have dropped significantly in Michigan since the introduction of the CLABSI checklist by the MHA Keystone Center for Patient Safety & Quality, all HAIs remain a concern. The future holds many challenges related to infection prevention and control – challenges that will continue to affect patient safety and healthcare quality, as well as patient morbidity and mortality.

It is important to note that the rates provided in this report are unadjusted rates from all participating hospitals. Therefore, comparison of rates throughout time may not be completely accurate, as the demographics of the participating hospitals have been shifting. The present hospital population may not be the same as the hospital population analyzed in previous reports. That is why, wherever possible, an SIR was calculated. An SIR risk-adjusts for the differences between hospitals to provide a fair overall view into the HAIs in Michigan hospitals. SIRs will be made available for MRSA bacteremia LabID events and CDI LabID events on the next report.

This report compiled Michigan HAI data voluntarily shared via NHSN with the MDCH SHARP Unit for the calendar year 2012 reporting period. This report followed the same structure as the previous 2010-2011 Annual Report with a few additional tables and graphs. Note that these data from participating hospitals have not been validated. Validation studies will be conducted as additional funding becomes available. This report contains data from many more facilities than in previous reports. Data will continue to become more reliable as additional Michigan hospitals participate in this surveillance initiative.

Acronyms

Below is a list of commonly used acronyms throughout this report to facilitate ease in reading.

CAUTI	Catheter-Associated Urinary Tract Infection
CCU	Critical Care Unit
CDC	Centers for Disease Control & Prevention
CDI	*Clostridium difficile* Infection
CI	Confidence Interval
CLABSI	Central Line-Associated Bloodstream Infection
CMS	Centers for Medicare and Medicaid Services
CO	Community-Onset
CO-HCFA	Community-Onset Healthcare Facility-Associated
DU	Device Utilization
DUA	Data Use Agreement
HAI	Healthcare-Associated Infection
HHS	U.S. Department of Health & Human Services
HO	Healthcare Facility-Onset
ICU	Intensive Care Unit
LabID	Laboratory-Identified Event
MDCH	Michigan Department of Community Health
MDRO	Multidrug-Resistant Organism
MHA	Michigan Health & Hospital Association
MRSA	Methicillin-Resistant *Staphylococcus aureus*
NHSN	National Healthcare Safety Network
SCA	Specialty Care Area
SHARP	Surveillance of Healthcare-Associated & Resistant Pathogens
SIR	Standardized Infection Ratio
SSI	Surgical Site Infection
VAP	Ventilator-Associated Pneumonia

Appendix 1	*Tests of Significance for Rates and SIRs over Time*						
	2010-2011 Annual Report			**2012 Annual Report**			
Infection Rates	Infections	Denominator	Rate	Infections	Denominator	Rate	**p-value**
MRSA LabID (per patient days)	993	226757	4.379137	2921	1516757	1.9258↓	**<0.0001**
MRSA LabID (per admits)	993	53793	1.845965	2921	351720	0.8305↓	**<0.0001**
CDI LabID (per patient days)	536	344737	15.54808	2933	1594695	18.3922↑	**0.0003**
CDI LabID (per admits)	536	104751	0.51169	2933	379062	0.7738↑	**<0.0001**
VRE LabID (per patient days)	93	115978	0.801876	419	415543	1.0083↑	**0.0420**
VRE LabID (per admits)	93	29000	0.32069	419	89352	0.4689↑	**0.0006**
CAUTI	122	117009	1.042655	964	423855	2.2744↑	**<0.0001**
CLABSI	176	244289	0.720458	296	353886	0.8364	**0.1159**
VAP	61	76890	0.793341	117	107618	1.0872↑	**0.0441**
SSI	368	19394	1.897494	1042	49175	2.1190	**0.0699**
CBGB	21	775	2.709677	36	1589	2.2656	**0.5179**
CBGC	0	53	0	3	119	2.5210	**0.3363**
COLO	72	934	7.708779	431	8797	4.8994↓	**0.0010**
FUSN	37	1529	2.419882	44	2221	1.9811	**0.3766**
HER	16	385	4.155844	20	1732	1.1547↓	**0.0004**
HPRO	53	2874	1.84412	82	5233	1.5670	**0.3604**
HYST	12	601	1.996672	163	8702	1.8731	**0.8033**
KPRO	35	4149	0.843577	72	7948	0.9059	**0.7390**
LAM	25	1296	1.929012	41	2021	2.0287	**0.8521**
VHYS	9	367	2.452316	7	515	1.3592	**0.2553**
Device Utilization (DU) Ratio	Device Days	Patient Days	DU	Device Days	Patient Days	DU	**p-value**
CAUTI DU	117009	397741	0.294184	423855	1139283	0.3720↑	**<0.0001**
CLABSI DU	244289	719983	0.339298	353886	1096079	0.3287↓	**<0.0001**
VAP DU	76890	259239	0.296599	107618	378193	0.2846↓	**<0.0001**
SIR	Observed	Expected	SIR	Observed	Expected	SIR	**p-value**
CAUTI	115	180.23	0.638074	933	825.503	1.130↑	**0.0000**
CLABSI	186	468.94	0.396639	329	722.746	0.455	**0.1322**
SSI	377	317.56	1.187177	982	1053.793	0.932↓	**0.0001**

Appendix 2.	*Tests of Significance for Rates Comparing Michigan to the US*						
	Michigan			**United States Comparison**			
Infection Rates	Infection	Denominator	Rate	Infection	Denominator	Rate	**p-value**
CAUTI	964	423855	2.2744↑	204412	135255305	1.5113	**<0.0001**
CLABSI	296	353886	0.8364↓	202352	213265459	0.9488	**0.0275**
VAP	117	107618	1.0872↓	25842	19608485	1.3179	**0.0333**
Device Utilization (DU) Ratio	Device Days	Patient Days	DU	Device Days	Patient Days	DU	**p-value**
CAUTI DU	423855	1139283	0.3720↑	135255305	480712135	0.2814	**<0.0001**
CLABSI DU	353886	1096079	0.3287↑	213265459	853310723	0.2499	**<0.0001**
VAP DU	107618	378193	0.2846↓	19608485	65732065	0.2983	**<0.0001**

Surveillance for Healthcare-Associated & Resistant Pathogens (SHARP) Unit

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